The Electrical World.

VOL. XXXII. NEW YORK, AUGUST 27, 1898. No. 9.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monaanock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

In the United States, Canada or Mexico; other foreign countries, $6.00.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

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AMERICAN ELECTRICAL EXHIBITS AT PARIS.

Now that the war is practically over, and it is evident that the country is about to enjoy a period of vast expansion of trade, it seems eminently proper that the attention of the electrical industry should be directed to the necessity for making an exhibit that will do it credit at the international exposition of 1900. Looking at the matter from a purely business standpoint, the country has been well advertised by the achievements of its arms, and the reputation of American machinery and methods has been enormously enhanced by the admirable work of the navy. We are therefore in a position to command a respectful hearing for our claims to pre-eminence in the engineering arts, and the opportunity offered at Paris is too good to lose. It is evident that we may look for our market in any quarter of the globe with less fear of successful competition than ever before. Our pre-eminence in electrical manufactures is incontestable, but it is not well to let pass the chance to make it evident to all who will see. The industrial development of Asia has only begun, and there is in Europe a vast field for our enterprise. There seems, then, to be every reason why American manufacturers should combine to make the American section at the exposition worthy of their reputation and of their country. Motives of expedience, of profit and of patriotism should unite to inspire the manufacturers here to excel their best former efforts and show the world what we can do in the arts of peace as a fit sequence to the exhibition but lately given of what we can do in war.

THE GENERAL ELECTRIC'S REDUCTION.

After a short delay caused by opposition of a technical legal character on the part of dissenting preferred stockholders the reduction of the General Electric Company's share capital from $34,712,000 to $20,827,200 was duly ratified at the adjourned meeting held in Schenectady, N. Y., on August 17. This settles the question of the reduction, and the company's books have been promptly closed for the carrying out of the plan, the exchange of the old stock for the new being scheduled to take place in about a month.

It does not seem that the opposition met with the approval of even a majority of the preferred shareholders, but in view of the company's circumstances the outcome now determined upon seems to have been about as fair a solution of the trouble as could be devised. By wiping out the impairment of capital, which is what this reduction of 30 per cent. in the outstanding stock virtually amounts to, the company at last corrects the error made when it was originally formed. As frankly stated in the circular issued by the directors in July this consisted of an overvaluation of patents, franchises and good will.

Having gotten rid of this cause of many trials and tribulations the company is now in a position to give its stockholders the benefit of the more profitable business conditions which are apparently coming in the industrial world. The facts in this case should serve as a warning against unwarranted overcapitalization and lack of preparation for hard times, or the changed conditions which are liable to occur in fields like the electrical, in which the prosperity of companies is likely to be affected by the advances in the sciences on which they are based. While no definite figures regarding the General Electric's earnings and profits are given to the public there is no doubt that the management can redeem the

pledge conveyed in its circular that from this time on it can pay full dividends on the reduced amounts of both classes of stock, which will be $2,551,200 of preferred and $18,276,000 of common. Under the circumstances the stockholders appear to have acted wisely in accepting the reduction.

FREQUENCY OF LIGHTNING DISTURBANCES IN ELECTRICAL APPARATUS.

There may be found on another page of this issue an article by Mr. C. P. Steinmetz, discussing the frequency of discharges set up in electrical transmission lines by lightning and other disturbances. In this connection it might be seen at first sight as though the frequency of the lightning discharge itself would be an important factor in that it would inductively impress itself upon the line and affect particularly such parts of the line as were approximately tuned by virtue of capacity and self-induction to resonance therewith. This, however, is probably not an important consideration due to the nature of the lightning discharge and its action upon the line. Mr. Steinmetz advances the idea that the lightning discharge proper may not be as a whole oscillatory. The stroke may start as a small discharge from rain or cloud particle to particle which occurs as soon as the difference in potential between the two drops of water rises to a sufficient value to strike across the intervening air gap, this almost infinitesimal equalization spreading from drop to drop, in general along the path of greatest charge of potential, increasing in intensity by accumulation of the charge of successive particles or decreasing and dying out when reaching parts of the cloud having lesser electrostatic charges. Thus the lightning stroke would be made up of an infinite series of successive discharges following each other as the disturbance spreads through space, and while each of these discharges might in itself be oscillatory the stroke as a whole would not have a definite period of oscillation. This theory is borne out more or less by the photographic reproductions of lightning discharges which show numerous forks and branches deviating from the main path throughout its length, these branches being as a rule inclined so as to follow more or less closely the general direction through space of the potential gradient. The theory is also borne out, as Mr. Steinmetz states, by the fact that it would not require such an extraordinarily high potential as would be required for a single stroke across a mile or so of space. This hypothesis would not apply, however, to a stroke to ground which might be considered the result of a gradual accumulation of small discharges until the aggregate accumulated sufficient volume to leap over the intervening space to the earth.

The principal effect of a lightning discharge in any case on an overhead transmission wire is a statically inductive one, instances of an actual stroke to the wires being rare. The accumulated charge in a cloud attracts and binds to the surface of all conductors near it and connected with the ground a charge of the opposite polarity. The transmission line below the cloud is sufficiently well connected with the ground (no matter how highly insulated) to gradually accumulate through leakage this static charge, its potential thus remaining the same as that of the ground below it, so long as the overhead charge remains unchanged. When, however, the charge of the cloud is neutralized by a lightning discharge to a neighboring cloud, the bound charge on the surface of the ground below is immediately released and flows off, leaving instantaneously a difference of potential of many thousands of volts between the line and the ground. This tends to discharge disruptively, and, owing to the influence of capacity and self-induction, to oscillate. The oscillations thus set up will be determined solely by the conditions of the line, so that the frequency can be correctly determined as Mr. Steinmetz derives it on another page by a quantitative discussion of the electrical properties thereof. As shown there the distribution of the line capacity renders the oscillations of an exceedingly complex wave form, with a fundamental not very much higher than frequencies in commercial use and a large number of harmonics.

Several valuable conclusions may be drawn from this, one being that ordinary choking coils, which might be effective against discharges of a greatly higher frequency, comparable with Hertz waves oscillations, for example, are absolutely ineffective with lightning discharges. One conclusion is that experimental operations with static machines and Leyden jars cannot represent the conditions of a long-distance transmission line and thus do not give reliable tests with lightning arresters, since such experimental tests give oscillations of one definite frequency and resonance phenomena for this frequency only.

SINGLE VERSUS MULTIPHASE SYSTEMS.

In the paper read by Mr. Ernst J. Berg before the recent meeting of the Ohio Electric Light Association, an abstract of which will be found in another column, the growing popularity of multiphase systems, especially of the two-phase, is strongly disapproved. Mr. Berg considers the use of the multiphase as only excusable where the distance of transmission is so great that the closest economy of copper with the highest permissible voltage is essential or where rotary transformers and direct-current distribution are used. Mr. Berg considers complete parallel operation an important requirement and does not, therefore, approve of the division of a lighting system between two phases. An advantage of the multiphase that Mr. Berg does not mention in his comparison is the improved economy of copper in the armatures of such machines and the more uniform reaction of such armatures.

On the question of frequency Mr. Berg also disapproves of recent tendencies and believes in the higher frequencies formerly considered best. This is also in spite of the fact that he brings out a new argument against such frequencies. This argument is the better action of dynamos in multiple with a lower periodicity. When two machines driven by engines, the angular velocity of which varies somewhat during each rotation, are run in multiple, if their frequency and the number of poles is high, a very small relative angular displacement will throw them considerably out of phase, while with a lower frequency and consequently a reduced number of poles the same angular displacement will make a correspondingly smaller phase displacement. On this account Mr. Berg states that it is often advisable to use lower frequencies rather than higher, but advises for lighting or alternating current distribution the use of sixty cycles at least, while for purely rotary converter purposes a lower frequency is permissible.

A New Cable Between the United States and France.

On August 17 the new cable of the French Telegraphic Cable Company was officially opened by the transmission of congratulatory messages between President McKinley and President Faure. The new cable runs from a landing on Cape Cod direct to Brest, being some 3400 land miles in length, the longest unbroken cable across the Atlantic. This is the second transatlantic cable of the French company, its older cable running via a landing on St. Clair Island, south of Newfoundland, where the messages are repeated. The new cable is single conductor, and for the present will be worked simplex, but will later be duplexed.

Resonance in Wireless Telegraphy.

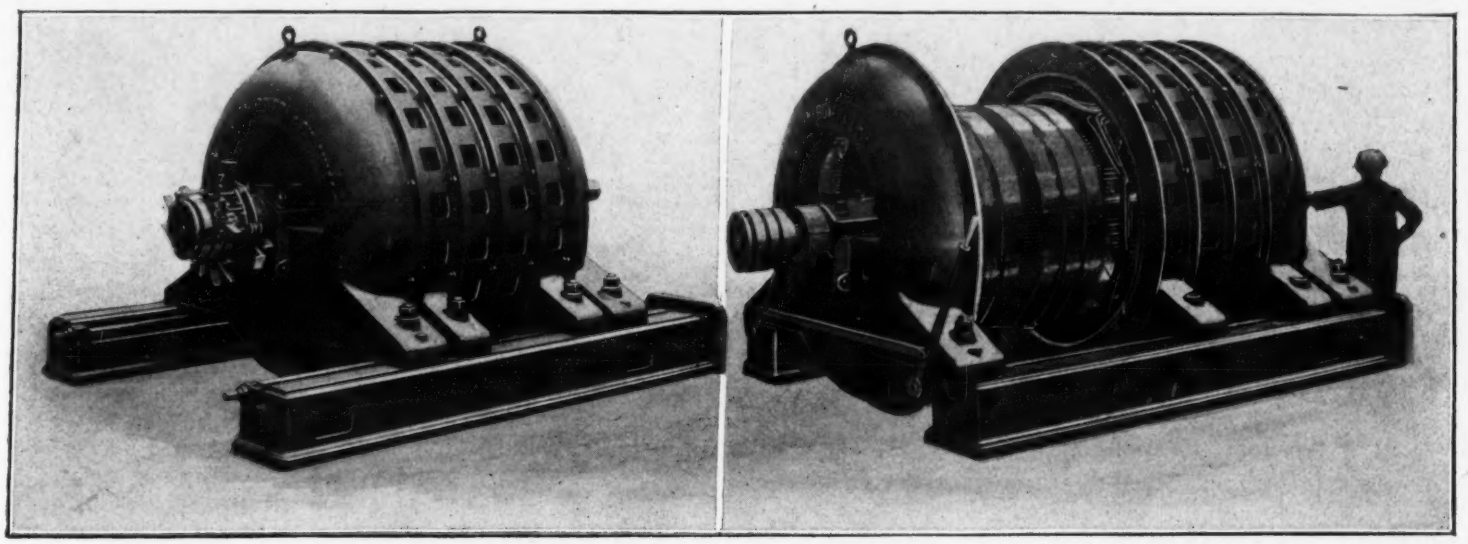
Those interested in the subject of telegraphy by means of Hertzian waves will find considerable information of interest in the patent of Oliver Joseph Lodge, No. 609,154, issued August 16, 1898, and noted in the record of electrical patents on another page of this paper.

The Largest Induction Motor in the World.

The accompanying photographs represent a two-phase motor for 1000 brake horse-power which has just been turned out from the works of Messrs. Brown, Boveri & Co., of Baden, Switzerland. As this is probably considerably the largest induction motor in the world, some details may be of interest.

The motor is intended to work in the municipal pumping station of the city of Geneva. The existing pumps, of the piston type, are driven direct by turbines, but as no further water power was available for extensions it was decided to put down a centrifugal pump driven by a two-phase motor deriving its power from the electric power house of Chèvres, some miles farther down the river. The pump for the exceptionally high lift of 460 feet is from the works of Sulzer Brothers, of Winterthur, and will be coupled directly to the motor here shown.

The motor is wound with ten poles, so as to run at a speed of 544 revolutions per minute when fully loaded, the frequency of the supply being 46 cycles per second. It is supplied directly with the high-tension current at 2500 volts. The total weight of the motor is 27 tons. It will be seen that the front cover plate is made to slide out on the prolonged bed-plate, so as to facilitate the removal of the rotating part. The circuits of the latter are brought out through the hollow shaft to three contact rings, for the use of a separate starting resistance in the secondary.*



A 1000-HP INDUCTION MOTOR.

The power house at Chèvres is also undergoing complete reconstruction, six new generators of 1200 horse-power each being now in course of construction in Messrs. Brown, Boveri & Co.'s works, as well as a new switchboard for all the generators and circuits, this switchboard being no less than 85 feet in length.

Convention of the Association of Fire and Police Telegraph Superintendents and Municipal Electricians.

This association held its last meeting in Elmira, N. Y., on August 9, 10 and 11. About sixty delegates were in attendance. They were welcomed to the city and entertained pleasantly. Several valuable papers were read and the following officers were elected for the coming year: President, J. W. Aydon, Wilmington, Del.; vice-president, C. T. MacDonald, Ottawa, Can.; treasurer, Adam Boesch, Newark, N. J.; secretary, H. T. Blackwell, Jr., New York; financial secretary, Burt McAllister, Bradford, Pa. The next meeting will be held in Wilmington, Del.

A New Source of Carbon for Calcium Carbide.

In a large lumber yard near Ottawa, Canada, there has been installed a retort for producing carbon from sawdust. It is almost needless to remark that this material is cheap, in fact so cheap that it is a matter of considerable expense in many large lumber yards to dispose of it by burning or otherwise. It is claimed that the charcoal obtained is purer than coke, and is therefore better suited to making calcium carbide.

*See also THE ELECTRICAL WORLD January 15, 1898, p. 89.

The Natural Period of a Transmission Line and the Frequency of Lightning Discharges Therefrom.

BY CHARLES PROTEUS STEINMETZ.

The discharge of a condenser through a circuit containing self-induction and resistance is oscillating (provided that the resistance does not exceed a certain critical value depending upon the capacity and the self-induction). That is, the discharge current alternates with constantly decreasing intensity. The frequency of this oscillating discharge depends upon the capacity, C, and the self-induction, L, of the circuit, and to a much lesser extent upon the resistance, so that if the resistance of the circuit is not excessive the frequency of oscillation can with fair, or even close, approximation be derived by neglecting the resistance, by the formula

$$N = \frac{1}{2\pi\sqrt{CL}}$$

An electric transmission line represents a capacity as well as a self-induction, and thus when charged to a certain potential, for instance, by atmospheric electricity, as by induction from a thunder cloud passing over or near the line, the transmission line discharges by an oscillating current.

Such a transmission line differs, however, from an ordinary condenser, in that with the former the capacity and the self-induction are distributed along the circuit.

The object of the following is to determine the frequency of the oscillating discharge of such a transmission line, which is the frequency of the discharge of atmospheric electricity, or of the oscillation set up when suddenly changing the condition of the circuit, as, for instance, opening the circuit.

For this purpose sufficiently close approximation is derived by neglecting the resistance of the line, which, at the relatively high frequency of oscillating discharges, is small compared with the reactance. This assumption means that the dying out of the discharge current by the resistance of the circuit is neglected, and the current assumed as alternating current of approximately the same frequency and the same intensity as the initial waves of the oscillating discharge current.

Hereby the problem is essentially simplified by the possibility of using the symbolic method of investigation.

Let c = total length of a transmission line;
r = resistance per unit length;
x = reactance per unit length $= 2\pi N L$.
where L = coefficient of self-induction or inductance per unit length;
g = conductance from line to return (leakage and discharge into the air) per unit length;
b = capacity susceptance per unit length $= 2\pi N C$
where C = capacity per unit length.
l = the distance from the beginning of the line,*

* "Alternating Current Phenomena," by Charles Proteus Steinmetz, second edition, paragraph 110, pages 161 and 160, equations 14 and 11.

The e. m. f.:

$$E=\frac{1}{g-jb}\left\{(A\varepsilon^{\alpha l}-B\varepsilon^{-\alpha l})\cos\beta l-j(A\varepsilon^{\alpha l}+B\varepsilon^{-\alpha l})\sin\beta l\right\}$$

the current:

$$I=\frac{1}{\alpha-j\beta}\left\{(A\varepsilon^{\alpha l}+B\varepsilon^{-\alpha l})\cos\beta l-j(A\varepsilon^{\alpha l}-B\varepsilon^{-\alpha l})\sin\beta l\right\} \quad (1)$$

where:

$$\alpha=\sqrt{\frac{1}{2}\left\{\sqrt{(g^2+b^2)(r^2+x^2)}+(gr-bx)\right\}}$$

$$\beta=\sqrt{\frac{1}{2}\left\{\sqrt{(g^2+b^2)(r^2+x^2)}-(gr-bx)\right\}} \quad (2)$$

ε = basis of natural logarithms, and A and B integration constants.

Neglecting the line resistance: $r = O$, and the conductance (leakage, etc): $g = O$, gives:

$$\alpha = O$$
$$\beta = \sqrt{bx} \quad (3)$$

These values substituted in (1) give:

$$E=\frac{j}{b}\left\{(A-B)\cos\sqrt{bx}\,l-j(A+B)\sin\sqrt{bx}\,l\right\}$$

$$I=\frac{j}{\sqrt{bx}}\left\{(A+B)\cos\sqrt{bx}\,l-j(A-B)\sin\sqrt{bx}\,l\right\} \quad (4)$$

If the discharge takes place at the point: $l = O$, that is, the distance is counted from the discharge point to the end of the line: $l = c$, it is:

At: $l = O$: $E = O$
At: $l = c$: $I = O$

Substituting these values in (4) gives:
For: $l = O$:

$$A - B = O \qquad A = B$$

These values substituted in (4):

$$E=\frac{2A}{b}\sin\sqrt{bx}\,l$$

$$I=\frac{2jA}{\sqrt{bx}}\cos\sqrt{bx}\,l \quad (5)$$

and at $l = O$:

$$I_o=\frac{2jA}{\sqrt{bx}} \quad (6)$$

At $l = c$: $I = O$, thus, substituted in (5):

$$\cos\sqrt{bx}\,c = O \quad (7)$$

hence:

$$\sqrt{bx}\,c=\frac{(2k+1)\pi}{2};\ k=O,1,2,\ \ldots \quad (8)$$

that is, $\sqrt{bx}\,c$ is an odd multiple of $\frac{\pi}{2}$. And at $l = c$:

$$E_c=\pm\frac{2A}{b} \quad (9)$$

Substituting in (8)

$$b = 2\pi NC$$
$$x = 2\pi NL$$

gives:

$$2\pi N\sqrt{CL}\,c=\frac{(2k+1)\pi}{2}$$

$$N=\frac{2k+1}{4c\sqrt{CL}}$$ the frequency of the oscillating discharge, where:

$$k = O, 1, 2. \ \ldots \quad (10)$$

That is, the oscillating discharge of a transmission line of distributed capacity does not occur at one definite frequency (as that of a condenser), but the line can discharge at any one of an infinite number of frequencies, which are the odd multiples of the fundamental discharge frequency:

$$N_1=\frac{1}{4c\sqrt{CL}} \quad (11)$$

Since:

$C_o = c\,C$ = total capacity of transmission line,
$L_o = c\,L$ = total self-inductance of transmission line, (12)

it is:

$$N=\frac{2k+1}{4\sqrt{C_oL_o}}$$ the frequency of oscillation, (13)

or natural period of the line, and:

$$N_1=\frac{1}{4\sqrt{C_oL_o}}$$ the fundamental, (14)

or lowest natural period of the line.

Substituting (10) gives:

$$b=2\pi NC=\frac{(2k+1)\pi}{2c}\sqrt{\frac{C_o}{L_o}} \quad (15)$$

$$\sqrt{bx}=\frac{(2k+1)\pi}{2c} \quad (16)$$

thus, substituted in (5):

$$E=\frac{4c}{(2k+1)\pi}\sqrt{\frac{L_o}{C_o}}A\sin\frac{(2k+1)\pi}{2}\frac{l}{c}$$

$$I=\frac{4jc}{(2k+1)\pi}A\cos\frac{(2k+1)\pi}{2}\frac{l}{c} \quad (17)$$

The oscillating discharge of a line can thus follow any of the forms given by substituting $k = 0, 1, 2, 3 \ldots$ into equation (17).

Reduced from symbolic representation to absolute values, by multiplying E with $\cos 2\pi Nt$ and I with $\sin 2\pi Nt$ and omitting j, and substituting N from equation (13), it is:

$$E=\frac{4c}{(2k+1)\pi}\sqrt{\frac{L_o}{C_o}}A\sin\frac{(2k+1)\pi}{2}\frac{l}{c}\cos\frac{(2k+1)\pi}{2}\frac{t}{\sqrt{C_oL_o}}$$

$$I=\frac{4c}{(2k+1)\pi}A\cos\frac{(2k+1)\pi}{2}\frac{l}{c}\sin\frac{(2k+1)\pi}{2}\frac{t}{\sqrt{C_oL_o}} \quad (18)$$

where A = integration constant, depending upon the initial distribution of voltage, before the discharge, and t = time after discharge.

The fundamental discharge wave is thus, for: $k = O$:

$$E_1=\frac{4c}{\pi}\sqrt{\frac{L_o}{C_o}}A\sin\frac{\pi l}{2c}\cos\frac{\pi t}{2\sqrt{C_oL_o}}$$

$$I_1=\frac{4c}{\pi}A\cos\frac{\pi l}{2c}\sin\frac{\pi t}{2\sqrt{C_oL_o}} \quad (19)$$

With this wave the current is a maximum at the beginning of the line: $l = O$, and gradually decreases to zero at the end of the line: $l = c$.

The voltage is zero at the beginning of the line, and rises to a maximum at the end of the line.

Thus the relative intensities of current and potential along the line are as represented by Fig. 1, where the current is shown in dotted lines, the potential in drawn lines.

The next higher discharge frequency, for: $k = 1$, gives:

$$E_3=\frac{4c}{3\pi}\sqrt{\frac{L_o}{C_o}}A\sin\frac{3\pi l}{2c}\cos\frac{3\pi t}{\sqrt{C_oL_o}}$$

$$I_3=\frac{4c}{3\pi}A\cos\frac{3\pi l}{2c}\sin\frac{3\pi t}{2\sqrt{C_oL_o}} \quad (20)$$

Here the current is again a maximum at the beginning of the line: $l = O$, and gradually decreases, but reaches zero at one-third of the line: $l=\frac{c}{3}$, then increases again, in opposite direction, reaches a second but opposite maximum at two-thirds of the line: $l=\frac{2c}{3}$, and decreases to zero at the end of the line. There is thus a nodal point of current at one-third of the line.

The e. m. f. is zero at the beginning of the line: $l = O$, rises to a maximum at one-third of the line: $l=\frac{c}{3}$, decreases to zero at two-thirds of the line: $l=\frac{2c}{3}$, and rises again to a second but opposite maximum at the end of the line: $l = c$. The e. m. f. thus has a nodal point at two-thirds of the line.

The discharge waves: $k = 1$, are shown in Fig. 2, those with $k = 2$, with two nodal points, in Fig. 3.

Thus k is the number of nodal points or zero points of current and of e. m f. existing in the line.

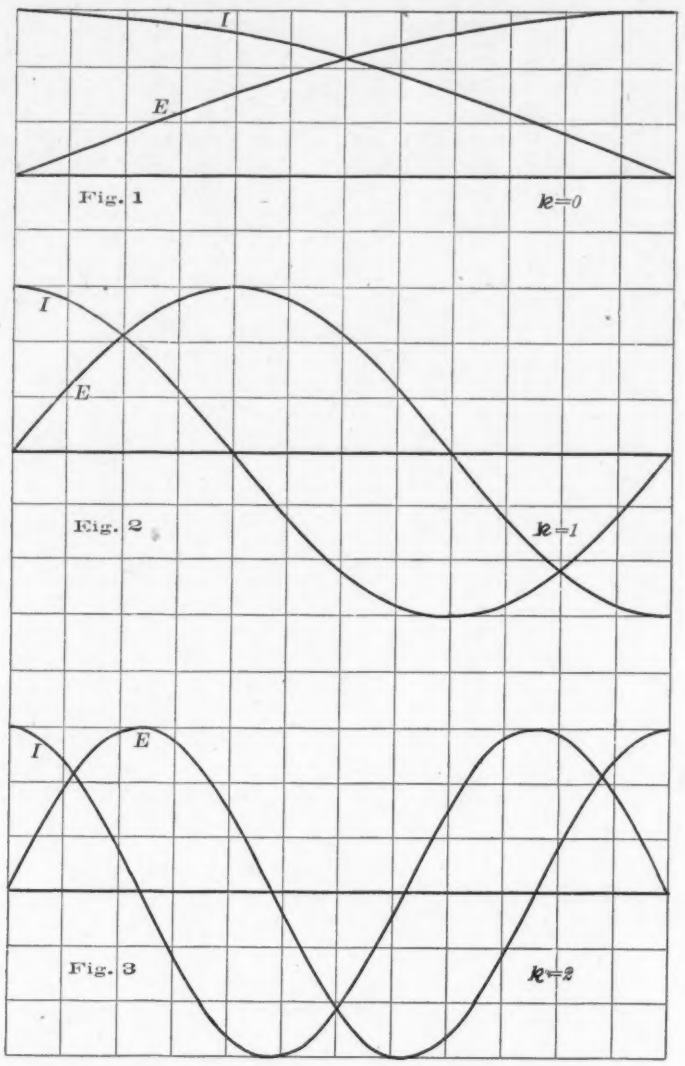
In case of a lightning discharge the capacity C_0 is the capacity of the line against ground, and thus has no direct relation to the capacity of the line conductor against its return. The same applies to the inductance L_0.

If d = diameter of line conductor,
D = distance of conductor above ground,
and c = length of conductor,
the capacity is:

$$C_0 = \frac{1.11 \times 10^{-6}\, c}{2\, lg \frac{4D}{d}}\ mf \qquad (21)$$

the self-inductance:

$$L_0 = 2 \times 10^{-6}\, c\, lg \frac{4D}{d}\ mh$$



The fundamental frequency of oscillation is thus, by substituting (21) in (14):

$$N_1 = \frac{1}{4\sqrt{C_0\, L_0}} = \frac{7.5 \times 10^9}{c} \qquad (22)$$

That is, the frequency of oscillation of a line discharging to ground is independent of the size of line wire and its distance from the ground, and merely depends upon the length c of the line, being inverse proportional thereto.

We thus get the numerical values:

Length of line	10	20	30	40	50	60	80	100 miles
$=$	1.6	3.2	4.8	6.4	8	9.6	12.8	16×10^6 cm.

hence frequency:

$N_1 =$ 4680 2340 1560 1170 937 5 780 585 475 cycles.

As seen, these frequencies are comparatively low, and especially with very long lines almost approach alternator frequencies.

The higher harmonics of the oscillation are the odd multiples of these frequencies.

Obviously all these waves of different frequencies represented in equation (18) can occur simultaneously in the oscillating discharge of a transmission line, and in general the oscillating discharge of a transmission line as thus of the former:

(by substituting: $a_k = \frac{A_k}{2k+1}$)

$$E = \frac{4c}{\pi}\sqrt{\frac{L_0}{C_0}}\left\{a_1 \sin\frac{\pi l}{2c}\cos\frac{\pi t}{2\sqrt{C_0 L_0}} + a_3 \sin\frac{3\pi l}{2c}\cos\frac{3\pi t}{2\sqrt{C_0 L_0}} + \ldots\right\}$$

$$I = \frac{4c}{\pi}\left\{a_1 \cos\frac{\pi l}{2c}\sin\frac{\pi t}{2\sqrt{C_0 L_0}} + a_3 \frac{3\pi l}{2c}\sin\frac{3\pi t}{2\sqrt{C_0 L_0}} + \ldots\right\} \qquad (23)$$

where $a_1\ a_3\ a_5, \ldots$ are constants depending upon the initial distribution of potential in the transmission line, at the moment of discharge, or at $t = 0$, and calculated therefrom.

As instance is calculated the discharge equation of a line charged to a uniform potential e over its entire length, and then discharging at $l = 0$.

The harmonics shall be determined up to the 11th—that is, a_1, a_3, a_5, a_7, a_9, a_{11}.

Those six unknown quantities require six equations, which are given by assuming $E = e$ for $l = \frac{c}{6}, \frac{2c}{6}, \frac{3c}{6}, \frac{4c}{6}, \frac{5c}{6}, \frac{6c}{6}$.

At $t = 0$, $E = e$, equation (22) assumes the form

$$e = \frac{4c}{\pi}\sqrt{\frac{L_0}{C_0}}\left\{a_1 \sin\frac{\pi l}{2c} + a_3 \sin\frac{3\pi l}{2c} + \ldots + a_{11}\sin\frac{11\pi l}{2c}\right\} \qquad (24)$$

Substituting herein for l the values: $\frac{c}{6}, \frac{2c}{6}, \ldots \frac{6c}{6}$

gives six equations for the determination of $a_1, a_3 \ldots\ldots a_{11}$. These equations solved give:

$$E = e\,(1.26 \sin\omega\cos\varphi + .40 \sin 3\omega\cos 3\varphi + .22 \sin 5\omega\cos 5\varphi + .12 \sin 7\omega\cos 7\varphi + .07 \sin 9\omega\cos 9\varphi + .02 \sin 11\omega\cos 11\varphi)$$

$$I = e\sqrt{\frac{C_0}{L_0}}\,(1\ 26\cos\omega\sin\varphi + .40\cos 3\omega\sin 3\varphi + .22\cos 5\omega\sin 5\varphi + .12\cos 7\omega\sin 7\varphi + .07\cos 9\omega\sin 9\varphi + .02\cos 11\omega\sin 11\varphi) \qquad (25)$$

where:

$$\omega = \frac{\pi l}{2c}$$

$$\varphi = \frac{\pi t}{2\sqrt{C_0 L_0}} \qquad (26)$$

Instance:

Length of line: $c = 25$ miles $= 4 \times 10^6$ cm.

Size of wire: No. 000 B. & S. G., thus: $d = 1$ cm.

Height above ground: $D = 18$ feet $= 550$ cm.

Let $e = 25{,}000$ volts = potential of line in the moment of discharge.

It is then:

$$E = 31{,}500 \sin\omega\cos\varphi + 10{,}000 \sin 3\omega\cos 3\varphi + 5500 \sin 5\omega\cos 5\varphi + 3000 \sin 7\omega\cos 7\varphi + 1750 \sin 9\omega\cos 9\varphi + 500 \sin 11\omega\cos 11\varphi.$$

$$I = 61.7 \cos\omega\sin\varphi + 19.6 \cos 3\omega\sin 3\varphi + 10.8 \cos 5\omega\sin 5\varphi + 5.9 \cos 7\omega\sin 7\varphi + 3.4 \cos 9\omega\sin 9\varphi + 1.0 \cos 11\omega\sin 11\varphi.$$

$$\omega = .39\, l\, 10^{-6}$$

$$\varphi = 1.18\, t\, 10^{+4}$$

A simple harmonic oscillation as a line discharge would require a sinoidal distribution of potential on the transmission line at the instant of discharge, which is not probable, so that probably all lightning discharges of transmission lines or oscillations produced by sudden changes of circuit conditions are complex waves of many harmonics, which in their relative magnitude depend upon the initial charge and its distribution—that is, in the case of the lightning discharge, upon the atmospheric electrostatic field of force.

The fundamental frequency of the oscillating discharge of a transmission line is relatively low, and of not much higher magnitude than frequencies in commercial use in alternating current circuits.

Long-Distance Transmission of Power.*

BY ERNST J. BERG.

When in the early '90s multiphase systems were introduced on a commercial scale it looked as if the field for the simple single-phase system would be very limited, indeed as if the latter be altogether superseded by the new systems; yet upon investigating all properties of the latter it was soon apparent that, although the multiphase systems were superior for some conditions, such as for the operation of motors, they did not compare favorably with the simple alternating-current system for lighting. Mistakes are often made in choosing the best system when contemplating a new installation. The reason for this mistake lies probably in the fact that it is generally assumed that alternating-current motors must run on multiphase circuits, and, therefore, even if the motor load does not amount to anything when installing a new plant, such a system has been adopted.

At the present stage of the art, there can be no question but that every central station man sees the advantages of parallel operation. By this is meant not only parallel running of generators in the station, but also multiple connection of the distribution system, whether direct or alternating current. This feature is most important as well for economy as for satisfactory operation sake. From the nature of things it is evident that the system must be divided when laid out multiphase, therefore when alternating current is used single phase should be adopted. Against this argument it is often stated that in a territory where the load is scattered greatly a secondary network cannot well be laid out, but each customer, or each set of customers, has to be supplied from his own transformer, in which case the distribution is single phase, regardless of whether the system is single phase or multiphase. If a multiphase system is used single-phase mains are brought over to the individual customer or groups of customers. This arrangement may look feasible on paper, particularly so if no investigations are made to determine the regulation in these single-phase mains. By a few calculations, however, it is readily found that although apparently everything is nicely balanced, such system is very often much unbalanced and consequently perfectly unsuited for its purpose. But even were it possible to distribute from a multiphase system with scattered transformers on each main, it is not at all correct to install such a plant, because any well-managed power distribution must sometime increase in magnitude, and arrangements should be made so that it can be changed over to a perfect system when needs be, which is only possible where each circuit has the same phase; that is, this is only possible with the single-phase distribution from a single-phase generator.

Still, a further reason for not adopting multiphase system is that by this time motors can be operated perfectly satisfactorily from a single-phase system; that is, single-phase system such as the monocyclic system.

As referred to above there may, however, be conditions which would warrant a multiphase, or rather a three-phase, installation, and these are when the distances between generating station and consuming circuit are so great that power cannot be transmitted from one to the other, except at the highest possible commercial voltage, without too great an expenditure of line copper; under such conditions the three-phase system, which takes 75 per cent. of the single-phase or two-phase copper, and say about one-half as much copper as the monocyclic system, may be preferable. For shorter distances, however, where it is not necessary to run at the limit of permissible voltage, the apparent saving in copper in the three-phase system over the monocyclic system is of little consequence, since the monocyclic system can be operated with the same amount of copper at a slightly higher voltage. Thus, excepting very long distance transmissions, the only field for multiphase system is in places where installation of rotary converters are warranted.

The next question of interest is the determination of proper frequency. The 60-cycle or 125-cycle lighting distributions are certainly preferable to the 25 and 40-cycle distributions; indeed, there can be hardly any question of installing anything less than 40 cycles, and such a low frequency can only be warranted by limitations in speed regulation of the prime mover. The tendency seems now to be to have direct-connected units as far as possible. Without arguing about this point, it seems that this is correct in most cases, yet undoubtedly it is carried too far in many instances. With very large units such as 1000 horse-power and more, there is no doubt but what the direct connection is better, but we often face propositions where the customer wants to install a direct-connected slow-speed 75 to 100-kw machine. That is, in my opinion, to carry things a little too far, since the slow speed necessitates very large and inefficient alternators with very many poles and engines with exceedingly close speed regulation.

In order to obtain satisfactory parallel operation of alternators it is necessary that their speed be uniform, and since no steam engine of reciprocating type can be made which gives a perfectly uniform rate of rotation, it is necessary to devise in some cases generators suited to the engines. It is often possible to build a 25-cycle direct-connected alternator which will operate perfectly satisfactorily from a given steam engine, whereas, if a 60-cycle alternator were installed on the same engine, its behavior would be so bad as to make parallel running prohibitive.

The amount of permissible variation is inversely proportional to the frequency of the alternator connected to the engine, so that, for instance, if a 20-pole alternator were directly connected to a steam engine which gives a speed variation of say one-half per cent., and it was desired to get as satisfactory results with a 40-pole alternator—that is, with an alternator giving double the frequency—it would be necessary to have one-quarter per cent. speed variation.

If belted alternators are used it is hardly ever necessary to consider lower frequencies than 60 cycles, since the question of speed variation of the engine is, of course, not of such importance as with the direct-connected engine, yet it may be given as a rule that two-crank engines should be used wherever possible.

Since incandescent and arc lighting are unsatisfactory with frequencies below 40 cycles, it is evident that we always have to consider either 40, 60 or 125-cycle systems, these being the standard frequencies, and of these the 125 or 60-cycle system should preferably be used, and the 40-cycle only when forced by the speed regulation of the engine.

As between 125 and 60 cycles, it is hard to give any rule. Were it not for the closer speed regulation required for the 125-cycle alternators I believe I favor them, particularly so if the distance of transmission is not so long that the line inductance may be objectionable, and if the secondary network is not too extensive and too large conductors used. Yet if a considerable motor load is anticipated, 60 cycles may be better. In connection with this it may be well to bring out the fact that 125-cycle iron-clad alternators are very well suited for parallel operation. Thus, a good rule regarding frequencies is to use as high a frequency as possible, and where no limitations are imposed by the driving power use nothing lower than 60 cycles.

With rotary converter installations the question of frequency is different. There the intention is not to distribute from the multiphase alternating circuit, but only through a direct-current network. The frequency of such a system is preferably 25 cycles, since at this frequency the regulation of the engines need not be so extremely good, and the rotaries can be built with relatively low speed. The three-phase system is, of course, preferable to the two-phase system, since it requires less copper, fewer lines, less switching arrangements, etc.

Sometimes, however, it is desirable to distribute the greater part of the load by means of the rotary-converter direct-current network, but also to do some lighting in another territory. Under such conditions, it is rather attractive to install a 60-cycle three-phase plant and use 60-cycle rotary converters, in which case the lighting could be directly done from the 60-cycle mains.

Considering, however, the high speed which is necessary in connection with the 60-cycle rotary converter and also the extremely close speed regulation of the engine or turbine driving the alternator, it may not always be good policy to use this frequency, but would be advisable to install a frequency changer in connection with a three-phase 25-cycle alternating-current generator.

Such a frequency changer can be used for transforming three-phase power to single-phase power, 25 cycles to 60 cycles, and any impressed voltage to another. For instance, with the frequency changer installed in Brooklyn power is transferred from 6600 volts, three-phase, at 25 cycles, to 2600 volts, two-phase power, at 62 cycles. This frequency changer is to all appearance an induction motor driven by a synchronous motor. Its capacity is greater than the capacity of a corresponding motor generator set and its efficiency is higher.

*Paper read before the Ohio Electric Light Association, August, 1898. Abstracted.

The Chicago & Milwaukee Electric Railway.

On July 1 a part of the Chicago & Milwaukee Electric Railway was put in operation. Although this line is not yet complete, and is now being operated by means of a temporary electrical equipment in the power house, it is thought that the plans for the complete installation, which have been developed by Mr. Bion J. Arnold, the consulting engineer for the company, represent such a radical departure from ordinary electric railway engineering practice as to justify a brief description at this time.

The line may be called an inter-suburban road. It runs through the chain of Chicago's most beautiful suburban districts lying along the shore of Lake Michigan, between Evanston and Waukegan. When the road is completed it will be hard to imagine a more delightful ride than it will offer. Beautiful suburban and country homes are scattered all along the way. The southern portion of the road is not yet completed, but north from Highland Park the line is now in operation. The route of the line is 30 miles in length and parallels for the entire distance the Chicago & Northwestern steam railroad. The name of the road would seem to indicate that it might eventually connect Chicago with Milwaukee.

The plan which was adopted for power generation and distribution consists of a combination direct-current and three-phase alternating-current system, with a generating station placed at the centre of the line. The sections of the road adjacent to the power station are supplied with direct current from the power house itself. Sections of the line at a distance from the power house get their supply of current from substations. The location of these sub-stations and their distance apart is governed by the conditions of traffic and somewhat by the nature of the grades along the line.

As shown upon the map, the power station is located at Highwood, and the sub-station for the operation of the northern portion of the road is situated near the southern limits of North Chicago. Connecting the power house with the sub-station is an 8-mile, 5500-volt, three-phase transmission line of three No. 8 wires. From the sub-station the 00 trolley wire is reinforced by a 0000 feeder extending 4 miles south and a 000 feeder extending 3½ miles north.

The line is at present operated on a single track road, except in Lake Forest, and a block signal system has been adopted to insure safety in operation. The fares charged are about one-half the rates charged upon the Northwestern Railroad for the same distances.

The plan of the power station is shown in the accompanying figure.

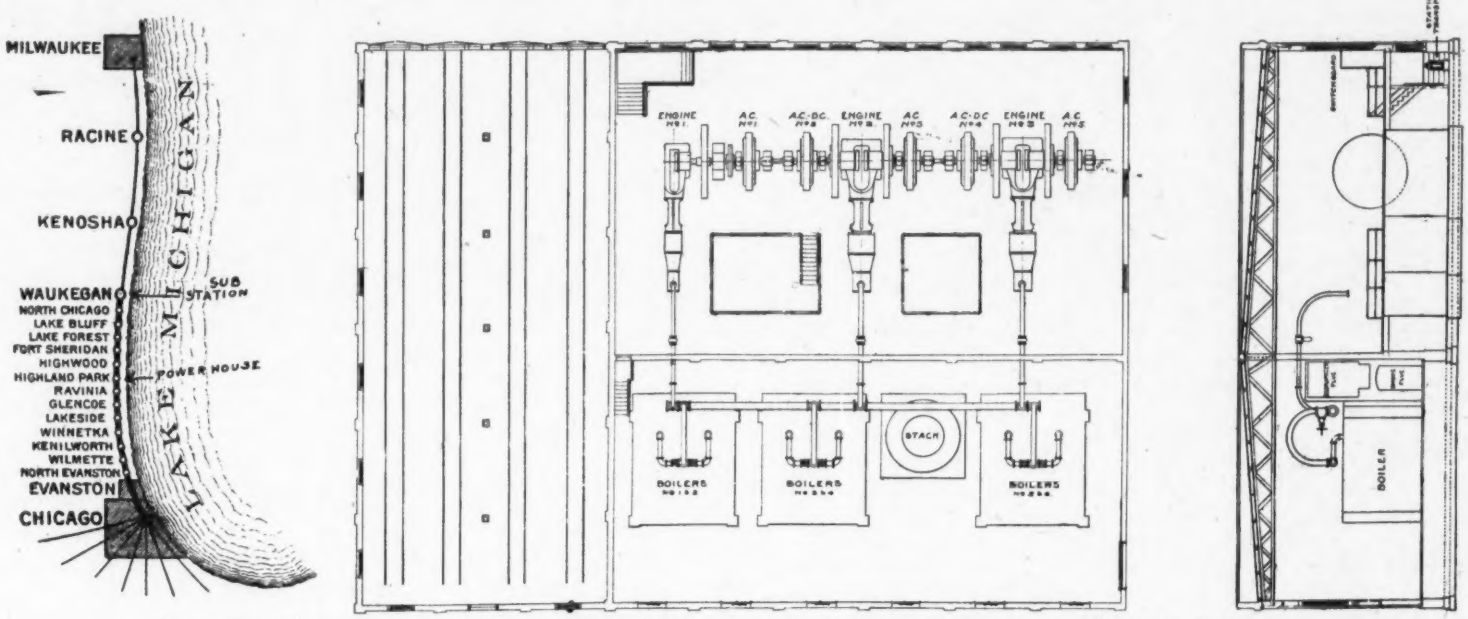
The unique feature of the power station, however, is the electrical equipment. Two different types of generators are employed: Generator No. 1, which is installed next to the engine No. 1, is an alternating three-phase generator of General Electric make. It has a capacity of 250 kilowatts at 125 revolutions per minute. This generator has 24 poles, and, therefore, delivers a three-phase current of 25 cycles per second. This current is generated at a potential of 5500 volts, ready to be delivered directly to the transmission lines without the use of transformers. Generator No. 2 is a combination generator. It is also of 250 kilowatts capacity, and runs at 125 revolutions per minute. It can deliver its output, however, either as direct or as three-phase current. It has but one armature, but the windings of this armature are connected on one side to a commutator and on the other side to collector rings. The potential of the direct-current end is 600 volts, while the three-phase current is delivered at a voltage of 380. The generator can deliver an output up to its rated capacity of 250 kilowatts from either the commutator or the collector rings. It can thus be used to supply current directly to the trolley passing in front of the power station, or can be used to operate the motors in the sub-stations, or for both purposes, at the same time dividing the load in proportion to the demand.

When the three-phase current from this generator is transmitted to the sub-station it is necessary to raise its potential from 380 volts to 5500 volts. This is accomplished by means of transformers placed in the basement, as shown. The transformers are cooled by a blast fan operated by a 1-hp induction motor. Generator No. 3 is to be a duplicate of generator No. 1.

The engines and generators are connected by means of the "Arnold System," which is particularly adapted to a station of this character, containing as it does two different types of generators. When the load is light the road may be operated from the alternating-current direct-current generator, and is always available from two engines. In case of a breakdown of one engine, this generator may be connected to the other engine. To secure this same reliability with the ordinary direct-connected independent-unit station, another engine and generator unit would have been necessary, as in such a plant an accident to an engine cripples the entire unit.

As the demand for the current varies the load may be transferred from one engine to another, or all engines may be operated in unison, which is important when working alternating generators in parallel. As each generator is mounted on independent bearings, it is possible, if occasion should arise, to operate generator No. 2 as a rotary converter, or even to connect generators Nos. 1 and 2, so that they could be used in the same manner.

These sub-stations are each to contain step-down transformers, a rotary converter and a storage battery. It will be noticed that the electrical equipment of the substations is not in duplicate. This has been considered unnecessary, as it is intended to mount the machinery needed for a sub-station, step-down transformers and one rotary converter, upon a truck fitted with motors. In case of breakdown at any sub-station, the battery can be relied on to supply current for several hours, during which time the portable reserve sub-station equipment can propel itself to the crippled station and be connected ready to operate until the repairs have been made.



MAP AND PLAN AND ELEVATION OF POWER STATION OF THE CHICAGO & MILWAUKEE ELECTRIC RAILWAY.

Convention of the Ohio Electric Light Association.

The fourth annual meeting of the Ohio Electric Light Association was held at the West House, Sandusky, Ohio, on August 18 and 19, a large number of members being present.

President H. K. Wood, of Piqua, called the meeting to order at 10:30 A. M., August 8. The first business laid down on the programme was the reports of committees, officers, etc., after the reading and adoption of which the president read his address.

After referring to the growth of the association and the good accruing to its members through organization, he touched upon the question of municipal ownership.

"There have been guerrillas in the bush in the past," he said, "and in the active competition for business in the future and the strong agitation for 'municipal plunder' we may reasonably look for them again. We do not have to review ancient history to learn there are men, yes, corporations, who, regardless of the months and years of anxiety of the local manager and stockholder, and their efforts to secure a fair compensation for their labor and capital, will, by one 'fell swoop,' endeavor to destroy and make worthless your investment. We should be 'united, vigilant and in the watch-tower,' for I fear the already troubled waters may soon need unusual and united effort to quiet them."

Speaking of the return of business prosperity, and the consequent demand for more light and power he suggested that the members should prepare their stations to meet the demand. He advised selling "our goods" upon their merits and not being driven to give satisfaction to a customer by a Welsbach burner or some new device.

Adjournment was then taken until afternoon.

At the afternoon session, which was called to order at 3 o'clock, the first business was the reading of a paper entitled "Positive and Negative Economies in the Operation of Small Electric Light Plants," by E. P. Roberts, of Cleveland, Ohio.

The author made his paper particularly interesting and valuable to those present at the convention by discussing the question not from the standpoint of one designing a new plant, but from the standpoint of one owning and wishing to run most economically a plant now in existence. A great many of these, probably the majority, can reduce their operating expenses by 10 or 20 per cent. if their officers are better informed as to the conditions under which they are operating and how to improve these. Examples are given, from the author's experience, of details. For instance, considering belts and shafts: Are the belts tighter than advisable? If so, it may be because they are oily or dirty; possibly the belt centres are too close together and this distance cannot be increased; possibly larger pulleys can be placed; preferably larger in diameter, but if this is not feasible wider in face. Will this pay? Assume that a belt transmitting 100 horse-power costs $100 and is running too tight and is adding 3 per cent. (3 horse-power) to the friction more than it would do if running loose. Suppose that the change to larger belts costs $75 and the extra belt costs $25, making a total of $100. Probably the life of the belt would be increased 50 per cent., say nine years as against six, with a saving of 3 horse-power, giving 1300 hp-hours per year. With a coal consumption of 4 pounds per hp-hour and coal costing $1.50 per ton, this gives a saving of $40 per year, and a reduction of the depreciation by $5, or a total of $45 saving, giving 45 per cent. on the investment, besides the improved reliability of service. How many managers would spend $100 to save a belt slipping? The station superintendent must get along with resin. This is certainly a negative economy. Other instances are given, taking up in detail the boilers, the engines, the shafts, electrical machinery, etc. The question of engine size was well discussed, the advice "Do not get your engine too small" being condemned and improved as follows: "Do not get your engine cylinder too large and do not get the other parts too small." This refers to an engine for a variable load, in which the average load may be considerably lower than that of the best steam economy. Small details like valve or piston leakage or improperly adjusted valve motions may readily cause 25 per cent. of the steam consumption. Station managers are advised above all things to keep records. In order to practice economy it must be known where saving can be made, and this requires a knowledge of what is being wasted. A tailor considers it necessary to know how much cloth is required to make a suit, but a producer of steam often considers the measure of his raw materials "theory." Whether theory or not, if it shows a way to a saving of 10 or 20 per cent. it is a good thing to have around.

A paper entitled "Some Suggestions Relative to Determining the Cost of Electrical Supply" was then read by Mr. M. E. Turner, of Cleveland.

The discussion of this paper related chiefly to the principle and operation of the Wright demand system, Mr. Scovil outlining a similar method of charging adopted by his company. It was the cause of some complaint among customers, who thought that the company was discriminating, but he was not going to operate his business to help a lot of people advertise their wares on Saturday nights, and the sooner the members cut off such customers the better it would be for them. In this connection Mr. Roberts mentioned a case coming under his experience. A ruinous competition of rates existed between the gas company and the electric light company in a small town, which resulted in the absorption of the gas company by the electric company. In order to provide business for both branches, saloons and such places were urged to use electric light, while gas was recommended for churches and other places with a poor load factor.

The meeting then adjourned until Friday morning.

The first business transacted at Friday morning's session was the reading of a paper by Mr. Caryl D. Haskins, of Boston, entitled "The Mete-'s Relation to the Dividend," an abstract of which will appear in a later issue of The Electrical World.

Mr. J. H. Perkins, of St. Louis, followed the discussion of Mr. Haskins' paper with a paper entitled "Comparative Commercial Qualities of Old and Modern Transformers as Applied to an Exchange."

The paper takes up the requirements of a modern transformer, discusses the losses, the regulation and the relations of these. It is almost an axiom in transformer design that with a given type, cost and weight per kilowatt, whatever is gained in copper loss will be lost in iron loss, and vice versa. The regulation is more or less proportional to the copper loss, so that where individual transformers without a secondary network are required the copper loss should be kept down. Under the same circumstances, however, the low-load factor renders the iron loss, which is a constant, a serious impediment to high efficiency. The best solution is the use of a secondary network wherever this is possible with a reduction of the iron loss, even at the expense of copper loss and regulation, since the copper loss is only serious at times of high load and the regulation can be corrected for in that case. Aging of iron is discussed and the paper states that the more able companies have solved the problem and are ready to make specific guarantees with a limit of from one to five years. Some recently developed grades of iron show absolutely no detectable change. The use of oil is commended. The saving on several installations, in which small old type transformers have been replaced by large modern ones, is described, curves being shown, showing in every case a very satisfactory rate of interest on the investment in new apparatus, besides the improvement in the reliability and satisfaction of the service.

After passing a vote of thanks to Messrs. Haskins and Perkins for their papers the meeting adjourned until afternoon.

At the afternoon session Mr. E. J. Berg, of Schenectady, N. Y., read a paper on "Long Distance Transmission of Power," an abstract of which may be found in another column.

After a vote of thanks to Mr. Berg for this paper the Question Box was opened. Question 1 was "What are the advantages of inclosed arc lamps for outside lighting?" Mr. Scovil, of Cleveland, stated that the inclosed arc lamp had obvious advantages over the open arc in the matter of saving of labor and carbons; they gave, besides, a steadier light. He had been informed that the Boston Electric Light Company effected a saving of $10 per year per lamp by the use of inclosed arcs.

Mr. Espy, of Kenton, gave an account of some experiments he had made by making the globe of an ordinary open arc lamp air tight. Lamps thus altered burned four or five nights on one trimming, and worked well both indoors and outdoors. The outdoor lamps, however, gave some trouble in wet weather by reason of the globes breaking. This damaging effect he supposed was due to the unequal temperatures within and without. No trouble was experienced in running the lamps with ordinary ½-inch x 12-inch carbons. As regards the candle power of altered lamps he could give no definite information. His customers, however, thought it was greater after their lamps were altered than before. The lamps were certainly giving better satisfaction, he said.

A member suggested that the life of the carbons was gained at the expense of the coal pile, by an increase of voltage at the arc.

Mr. Espy, however, thought that such was not the case, as the lamps took the usual amount of current and at the ordinary voltage—there was no increase of voltage.

Question 2 was "Can the candle power of arc lamps be accurately determined by the use of a portable photometer?" The consideration of this question was very brief. Mr. E. P. Roberts stated that the candle power of arc lamps could be so measured, but it would be too inconvenient a method to use in practice.

Question 3, "In what way can competition of the gasoline incandescent burner be most successfully met?" being one of particular importance to the Ohio electric light men, elicited some discussion, in which considerable information on the subject of gasoline plants was developed. Mr. Espy explained that the gasoline incandescent system comes in direct competition with electricity in small towns. He understood that an 8 or 10-light plant could be installed in dry goods stores, etc., at a cost of $50 or $60. They are maintained very cheaply, and in some Ohio towns excellent results had been attained. In this system of lighting the Welsbach mantle is used, the gas being generated on the premises. The best field for this system of lighting was in small towns which could not afford an electric or gas plant.

Mr. Berg stated that he had been testing a Welsbach light in his house and found by photometric measurements that its candle power runs down rapidly. After six months' use of his light on a daily average of four hours, he did not get half as much light from it as from an incandescent lamp burned under similar conditions.

Mr. Roberts stated that while Welsbach burners had been very much improved in the past two years they deteriorated in use, particularly under the effect of frequent lighting and extinguishing of the gas. They gave longer life when burned more continuously. He thought that members need not worry over the Welsbach burner. The best way to handle the subject was to let it alone. Experience has proved that people soon get tired of replacing broken down mantles. These people soon came back again to electricity.

Mr. Scovil gave some figures showing the cost of Welsbach lamps to the city of Cleveland. Some of the ordinary gas burners had been changed to Welsbach burners, and the city was paying $31 per lamp per year as against $16 for the old style. One Welsbach replaced two ordinary burners, but he thought the distribution of light was not so good.

Question 4, "Is it advisable for a plant to change from 15,000 volts alternating single-phase to 7200 volts, two-phase, if no question of motor business is concerned?" was passed over, since the subject was discussed quite fully in Mr. Berg's paper.

Question 5, "What are the types and makes of engines in use in the smaller plants of the association; the time of their installation and their condition at the present time?" did not extract much information from the members. Mr. Roberts, however, stated that in his experience he found that in the smaller plants in Ohio the average engine used was the high or medium-speed automatic non-condensing type, single valve, working on a pressure of from 80 to 90 pounds. Their life, of course, depends upon how they are maintained. He had found many cases of mismanagement.

President Wood then announced that the next year's meeting of the association would be held in Cleveland at a time to be set by the executive committee.

In bringing the convention to a close President Wood made a few appropriate remarks upon his retirement, thanking the members for their earnest support and attention to business. The meeting he thought was the best the association had yet held. At 5 P. M. the convention adjourned.

The following named gentlemen were chosen at the morning session of the executive committee as officers for the ensuing year: President, Emil C. Schmidt, Sandusky; vice-president, B. P. Holmes, Youngstown; secretary and treasurer, Samuel Scovil, Cleveland.

On Saturday, through the courtesy of the Sandusky Lighting Company, which was represented by Mr. Emil C. Schmidt, superintendent, the members and their friends enjoyed an excursion to Put-in-Bay, where dinner was served at the Hotel Victory. An orchestra was provided by the Warren Electric Manufacturing Company, and the music was an added pleasure to the enjoyment of the trip.

The day was a delightful one, and the ride was keenly enjoyed by all who had the good fortune to avail of the Sandusky Company's hospitality.

The Parallel Running of Alternators.*

The conditions of parallel running of alternators are, briefly, to have uniform speed of the driving power, and to adjust the speeds of the alternators which are to run in multiple so that they run at the same rate. Alternators capable of absorbing approximately the full capacity of their driving powers and operated from independent prime movers are most readily run in multiple. Thus, for instance, two alternators, each of which is belted to a steam engine of its own size, present an easy problem and can most readily be run in parallel, at least if the engines are of the cross-compound type and the belts reasonably good. Such alternators can be thrown in parallel, even should the speed not be exactly the same, but with the phasing lamps flickering at the rate of, say, one pulsation in two seconds.

Direct-connected alternators, operated on engines of sufficiently close speed control, as well in regard to variation in speed between no load and full load as change of rate of rotation during one revolution, can also be thrown in multiple at the same rate of pulsation of the phase lamps.

Alternators driven from the same countershafting offer a somewhat more difficult problem, and in such case it is necessary that their speeds should be closer when thrown in multiple, therefore great care has to be taken that the pulleys are of exactly the same size and the belts running smoothly. A flickering of phase lamps corresponding to a period of, say, five seconds at least should be obtained before attempting parallel running.

Alternators driven from independent countershafts, which are supplied with much more available power than the alternators can absorb, offer an exceedingly difficult problem in parallel operation. For instance, assume that two alternators are of 50-kw capacity and operated by engines of 500 or 600 horse-power, these offer an exceedingly difficult problem, since with them the synchronizing action of the alternators may not suffice. The pulleys must under such conditions be adjusted exceedingly close. This is particularly the case if the two countershafts are not interconnected by a large belt; thus, briefly, the ease with which alternators can be thrown in multiple depends not so much on the alternators themselves, but upon the condition of the driving power.

The best condition is belted alternators operated from independent driving power of approximately the same size as the alternators themselves, or direct-connected generators on close regulating engines.

The next condition is alternators operated from different countershafts, which, however, supply chiefly the loads of the alternators themselves. Next alternators operated from the same countershaft, then alternators operated from different but inter-connected countershafts, where the capacity of the alternators is small compared with that of the countershafts themselves; and, finally, the worst case is when alternators are operated from different countershafts which are not joined together by belting, and the size of the alternators is small compared with the output from the countershafts.

Some Suggestions Relative to Determining the Cost of Electric Supply.†

BY M. E. TURNER.

At the National Electric Light Association Convention in '97, Mr. Arthur Wright, of Brighton, England, read a paper in which was developed a method of charging a consumer for electrical current based on the cost of the consumer to the supply company.

The foundation of this system is the proportioning of all expenses into, First: Those which are fixed, or those which remain about constant, only changing as the number of consumers increases, or as the territory is extended, or as the capacity of the station is increased, or as the investment is increased. These are termed standing charges.

Second: Those expenses which increase or decrease with the output of the station; that is, the number of kw-hours or hp-hours manufactured.

To illustrate this method I have taken a station operating an Edison system with underground distribution, and have divided the total expenses into four general headings, viz.: Manufacture, distribution, general expense and fixed charges.

*An abstract of the discussion following the reading of Ernst J. Berg's paper at the Convention of the Ohio Electric Light Association.

†A paper read at the Convention of the Ohio Electric Light Association, Sandusky, Ohio, August, 1898. Abstracted.

Manufacture includes all expenses incidental to the work in the station, such as fuel, water, oil waste and packing, removal or disposition of ashes, labor, repair and maintenance of engines, boilers, auxiliary engines and piping, electrical machinery, tools, building and incidental expenses.

Distribution includes all expenses of repair and maintenance of underground conductors, tools, meters, inside wiring, etc., and overhead lines.

General expense includes all expenses, such as salaries of officers and superintendents, rents, taxes, insurance, legal and sundry expenses, casualties, etc.

Fixed charges include the interest on all outstanding capital and a depreciation item which is an amount to be charged off against the life of the property.

In the following determinations the depreciation is taken at 5 per cent. of the cost of the plant.

It is now necessary to arrange these various items into either standing or running accounts. Let us start with manufacture. Fuel you will find is proportional or nearly so to the kw-hours manufactured. To show this take the fuel account of your own station for six summer or light months, and for six winter or heavy months, also the kw-hours manufactured for the first period, then for the second period. Dividing the cost of fuel by the kw-hours you will find that the kilowatts you manufactured cost as much for fuel during a summer as a winter month.

Next, oil, waste and packing. These items are found to vary more with the number of hours the machinery is run than with the work done or the output manufactured. It takes almost as much of these items to run engines light as heavy, yet about half the expenses of these items are due to extra engines run at maximum or to the length of time run. So one-half has been proportioned to standing and one-half to running. The removal of ashes being proportional to the coal burned will be readily seen to be a running cost.

By the same course of reasoning, labor in the station would be placed under the head of standing charges, but as a considerable part of the labor is used in handling coal and ashes, and a part in the handling of oil, it has been considered best to place a portion of it under running charges, and in this example I have placed one-half to running and one-half to standing.

Next, take the repair and maintenance of boilers. As these repairs or expense come irregularly, the formula cannot be applied. By watching closely the repairs it will be seen that quite as much expense is caused by the length of time of use as by the output or power delivered. This is also true with the repair of engines, steam piping, pumps, electrical machinery and the building.

It has been thought best to divide these accounts as follows:

Fuel, water and ashes, all to running.

Labor, oil, waste and packing, one-half to running, one-half to standing.

Renewal and repair of engines, one-third to standing, two-thirds to running.

Renewal and repair of boilers, electrical machinery and piping, one-half to standing, one-half to running.

Incidental expenses, renewal and repair of building, tools and instruments, all to standing.

Under distributing expenses, take the repair and maintenance of underground conductors or overhead lines. A careful examination of the causes of the expenses of this work will show that they are neither caused by nor proportional to the output or power transmitted, but are caused by the breaking down of the insulation, due to the pressure carried, or by the weather, or by poor workmanship or faulty material, or by such other causes. But none or almost none are due to the output transmitted. This is also true with the meter accounts, the tool and instrument account, and the inside wiring account, so that all of these expenses are standing expenses.

All of the general expenses belongs to the standing charges. Whether the plant operates under heavy or light load, the organization of the company must be maintained, insurance carried, taxes paid, and damages settled. The output might be doubled without increasing these expenses, or might be cut in half without decreasing them. This principle applies unquestionably to the inteerest and depreciation charges, which are also standing charges.

The next step is the totalizing of all standing charges. This total standing expense or charge is proportional to the kw-capacity installed, and will increase as the size and the capacity of the plant is increased. For, as the engines, boilers, generating and piping are increased, so will the standing charges of these accounts increase, and as the number of miles of underground or overhead lines are increased, so are the expenses of repair and maintenance increased. Now, these standing expenses, being proportional to the capacity, should be divided by the kilowatts installed at the end of the period at which the capital is taken. This gives us the annual standing charge per kilowatt of capacity installed, which divided by 305 days gives the cost per day. (Three hundred and five days are taken, they being working days, Sundays and holidays being excluded.)

In order to apply these principles and to show what a large proportion of the total cost the standing charges are, let us take the example referred to before. We will assume that the capital cost of plant, station and lines is $500 per kilowatt of station capacity installed. We will assume that the sum of all the running charges is 1 cent per kw-hour. This sum is derived from the items previously mentioned.

This gives a total standing cost of $82 per annum for each kw-capacity we have installed, or in other words, a cost to us of $82 per year for each kw-capacity we keep at a customer's disposal, whether we generate for this customer current from this apparatus for one hour or for twenty-four hours per day. Next, dividing $82 by 305 days, gives us 26.9 cents per day. Now, if the consumer uses a maximum of one kw-capacity, his cost to us per day would be 26.9 cents, plus the running cost per kw-hour multiplied by the number of kw-hours he uses. For instance, for one hour's use it would be 26.9 plus 1 cent or 27.9 cents, for two hours' use it would be 26.9 plus 2 cents or 28.9 cents or 14.95 cents per kw-hour.

A Great Advance in Fire Alarm Telegraph Protection.*

I desire to present to the convention a brief description of a most important and recent advance in methods of fire alarm protection, which will make the outbreak of a fire and the sounding of the alarm through the municipal system practically simultaneous.

I refer particularly to a combination of the well-known Gamewell auxiliary fire alarm system and the cable of the Montauk Multiphase Cable Company, which combination makes the Gamewell auxiliary system automatic as well as manual.

The auxiliary system was a great step forward, in that it brought the nearest public fire alarm box into the interiors of buildings, and placed it at any desired number of points, by providing a series of small auxiliary boxes, from any one of which the street box could be instantly operated. But the system, being purely manual, was not effective when the protected premises were vacant; and it was to cover this point that a method of rendering the auxiliary system automatic as well as manual was perfected. It has never been a matter of electrical or mechanical difficulty to connect ordinary thermostats into an auxiliary system, so that an excess of heat would automatically operate the street box, but the danger of unnecessary alarms has prohibited this.

The recent invention of the Montauk "multiphase cable" referred to above is adapted for use in connection with the auxiliary system, so that it becomes automatic as well as manual, without the sacrifice of any of the peculiar features of safety from false alarms, which is the foundation of the willingness of fire departments to allow its use in connection with street boxes.

Such an automatic auxiliary equipment would consist of the desired number of auxiliary boxes, distributed throughout a building at convenient locations, connected through the usual apparatus with the nearest street fire alarm box, with the interior wiring of the equipment of this "multiphase" cable.

As fires do not start upon the ceilings of rooms (where ordinary thermostats are placed), the automatic wires which would be run around baseboards, back of benches, through closets, under staircases, etc., could be more readily made to cover every danger point where a fire would be likely to start. These danger points can be scientifically located for each class of risk by reference to insurance tables giving the accumulated experience of all of the insurance companies for a period of years, as well as by individual judgment in each case.

Since it takes actual flame, or a temperature of 360° without flame, to cause this wire to send in an alarm, this prevents false alarms from the overheating of a building, which might not necessarily be dangerous.

*Abstract of paper by J. W. Aydon, superintendent fire and police telegraph, Wilmington, Del., at the third annual convention of Fire and Police Telegraph Superintendents and Municipal Electricians, Elmira, N. Y., Aug. 18, 1898.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

TANDEM COUPLING OF MULTIPHASE MOTORS. Reithoffer. "Elek. Neuigkeits Anz.," August 1.—A description of the method used by the (foreign) Thomson-Houston Company. Two identical motors are coupled to the same shaft; the stationary part of one receives current from the line, say a three-phase current with a frequency of n; the stationary part of the second motor obtains its current from the armature of the first through sliding brushes; the armature of the second motor is short circuited through regulating resistances; the frequency of the multiphase currents generated in the first armature depends on the slippage; if m is the speed of the two motors, then n-m will be the frequency of this current; the speed of the two coupled motors will then be approximately half of the full speed. It does not follow, however, that, because the slippage is about 50 per cent. the efficiency is below 50 per cent., as part of the energy generated in the first motor is used in the second. The general case is briefly discussed mathematically. By means of switches the two motors may be either connected in parallel, both being supplied from the outside circuit, or in cascade or tandem, and they may thus be made to have two speeds. The switching must be so arranged that the rotating field revolves in the direction of rotation when it is developed in the stationary part and in the opposite direction when it is generated in the moving part, in order to help the rotation of the motor.

SPARKLESS REVERSAL IN DYNAMOS. Allen. Lond. "Elec. Eng.," August 5.—The begnning of a reprint of the article noticed in the "Digest" May 7.

TRANSFORMER LITIGATION.—Lond. "Elec. Rev.," August 5.—A short article calling attention to the fact that the present owners of the nearly expired Zipernowski and Deri fundamental transformer patents are about to use them to obtain royalties from those using transformers in England.

ARMATURE MAGNETIZATION.—"Amer. Elec.," August.—A short editorial article discussing what is good practice in armature magnetization, a subject on which dynamo builders differ very widely. Armature densities vary from 40,000 to 90,000 lines per square inch, the English, as a rule, using high densities and the Americans lower; the density should depend on the conditions that are to be met in the design; if, for instance, a slow speed is desired a high density must be used, while if overload capacity is desired high density should be avoided; it does not follow that a high density in an armature means light weight of the machine, for generally little is gained in this direction by such practice; the diminished area of the air gap will increase the reluctance and leakage so as to require exciting coils of greater weight. For high densities it is very important to carefully select the iron for the armatures, as it is frequently so highly susceptible to hysteresis losses that it would heat dangerously from hysteresis alone. The concensus of modern opinion seems to be that density is something like speed; it may be increased above a certain limit to gain other advantages, but as a general rule it cannot be increased over 50,000 lines to the square inch without serious sacrifice.

SPEED-REDUCING RESISTANCE. Heldt. "Amer. Elec.," August.—An article of an elementary character explaining how the resistance in a motor circuit is calculated when it is desired to reduce the speed to a definite amount. The torque at a given speed is first determined by a simple calculation from the power and speed, after which the resistance is calculated, which will give the current required for that torque. It is illustrated by an example.

ARMATURE WINDINGS. Rice. "Amer. Elec.," August.—Diagrams and explanations of multipolar windings in which the coils consist of cables wound on forms.

WINDINGS OF MULTIPHASE ARMATURES. Stone. "Amer. Elec.," August.—A number of diagrams showing the most useful multiphase armature windings that are used in American practice.

INDUCTION MOTOR. Wiener. "Amer. Elec.," August.—The third installment of his serial; he describes the induction motor field winding with the aid of a large number of diagrams.

DESIGNING A DYNAMO.—"Amer. Elec.," August.—A short, elementary article explaining how to design a dynamo.

HOME-MADE TRANSFORMER.—"Amer. Elec.," August.—An illustrated article with working drawings, showing how to design a small transformer, which can be easily made by an experimenter for his own use, as it requires no machine work.

Lights and Lighting.

HEAT COMPENSATOR IN ARC LAMPS.—Lond. "Elec. Rev.," August 5.—An illustrated description of the Koerting and Mathiesen compensator, which was noticed in the "Digest" June 11.

INCANDESCENT LAMP RESISTANCE. Shedd. "Amer. Elec.," August.—A short, illustrated article of an elementary character pointing out the resistance properties of carbon which make it suitable for incandescent lamp filaments.

Power.

RAND CENTRAL ELECTRIC WORKS. Klug. "Elek. Zeit.," August 4.—A long, illustrated description of the electric power transmission plant of this company at Johannesburg, South Africa. Other descriptions of this plant have already been referred to, but this one seems to be more complete.

SOO POWER PLANT.—"Amer. Elec.," August.—An illustrated description of this plant at the Sault Rapids, below Lake Superior; 40,000 horse-power can be delivered at the turbine shafts; there will be a 375-kw slow-speed alternator coupled to each turbine shaft, delivering current at 200 volts, with a frequency of 60. The armatures are stationary and the fields rotate. (Other descriptions have already been referred to.) See THE ELECTRICAL WORLD, August 6, 1898.

WATER-POWER STATION. Hobart. "Amer. Elec.," August.—Some hints concerning the operation of a plant in which water power and steam power are used together to drive a generator.

COAL MINING PLANT. Gresley. "Eng. News," August 18.—A long abstract of a paper read before the (English) Inst. of Civ. Eng., describing the plant at Scott Haven, Pa.

PROPOSED METHOD OF LONG-DISTANCE TRANSMISSION. Asher. "Elec. Rev.," August 17.—A suggested system in which he intends to place a transformer having a ratio of one to one (that is, with identical coils), at the extreme distance to which the power can be transmitted, and then send the current from the secondaries to an equally great distance to another, and so on, believing that thereby great distances could be covered. For continuous currents he suggests the use of rotary transformers. (What he proposes to gain by inserting these transformers instead of leaving them out entirely is not described; the fallacy of the suggestion is self-evident. Were he to use them to recuperate the line loss at the expense of the current there might be some element of use in the system).

Traction.

HEAVY RAILWAY LINE.—Lond. "Elec.," August 5.—few notes about a plant at Thun, Switzerland, which is being built and which will be the first attempt in that country to use electricity on a large scale for heavy railways. A waterfall will be used having a head of 215 feet, and there will be four turbines of 900 horse-power each for the present, driving three-phase dynamos generating current at 4000 volts for the neighboring localities; this is raised to 16,000 for long-distance transmission; about half the power will be transmitted to Berne, 25 miles, being reduced to 3000 volts outside of the city; the other half is to work a 25-mile railway from Burgdorf to Thun; there will be eleven transformer stations along the line and 60-hp three-phase motors on each axle of a four-axle car carrying sixty passengers; owing to the heavy gradient the speed will be only 26 miles per hour.

ELECTRIC TRACTION AT THE PARIS EXPOSITION.—"Elek. Neuigkeits Anz.," August 1.—A brief description of this line, to which other references have already been given.

ELECTRIC RAILWAYS IN EUROPE. Lauriol. "L'Eclairage Elec.," July 30.—A brief abstract of his recent report (see "Digest" last week, under "Installations, etc.").

CONDUIT RAILWAY SYSTEMS.—"L'Elec.," August 6.—An editorial article enumerating the particular characteristics which distinguish the various systems and the reasons for their adoption. No conclusions are drawn.

ELECTRIC LAUNCH. Preller. Lond. "Engineering," August 5.—A brief, illustrated description of the 33-foot electric launch on the Walen Lake, in Switzerland. It carries twenty passengers, and contains forty-four accumulators, having a maximum capacity of 210 ampere hours, operating a 3-hp motor. The weight, cost and working expenses are given, the weight and cost of the battery motor being 0.6 tons and $520 per horse-power respectively; a mineral oil motor would weigh and cost 0.4 ton and $200 per horse-power, respectively.

AUTOMOBILES.—"L'Energie Elec.," August 1.—A long, illustrated description of the electric vehicles exhibited at the recent exhibition in Paris. There were altogether 250 vehicles exhibited, of which thirty were electric, and exhibited by ten exhibitors. With but few exceptions the illustrations give only external views, showing very little detail.

AUTOMOBILES.—Lond. "Elec. Rev.," August 5.—An abstract of Hospitalier's paper noticed in the "Digest" August 6.

FREIGHT TRAFFIC ON SUBURBAN TROLLEYS. Bonner. "Elec. Eng.," August 18.—A plea for the introduction of a system of freight traffic on suburban trolleys. He shows the relatively great cost of moving freight by horses over ordinary roads, giving a table of actual observations of the cost of moving 1 ton 1 mile over different pavements, including rails; the average cost of transportation by animal power, based on many statistics, is about 25 cents per ton mile. He recommends a system in which the freight is loaded on what he calls rail wagons, which are drawn by horses and are then run on a low truck on the trolley tracks, on which they are then drawn by an electric locomotive. See The Electrical World, July 16, 1898, p. 66.

POWER CONSUMPTION IN ELECTRIC RAILROADING. Dodd. "Elec. Eng.," August 18.—A reprint of the article noticed in the "Digest" February 19. He calls attention to the fact that so much more power seems to be required on trolley cars than on the horse cars formerly used, and makes an analysis of the losses occurring in street railway operation to show that the power used is no greater than might be expected.

TROLLEY LIGHTERS. Hibbard. "Sc. Am.," August 6.—He proposes the use of a system of lighters for the Chicago River, which are to be operated by a propeller driven with currents from trolley wires. He proposes four lines of double trolley wires, two along the centre and one along each dock; the motors could also be used to furnish power to unload the boats.

CAST-WELDED JOINTS.—"El'ty," August 17.—A reprint without the illustrations of the article noticed in the "Digest" last week.

ACCUMULATION TRACTION. Bayly. "Elec. Rev.," August 17.—An illustrated description of the Madeleine line in Paris. (Other descriptions have already been referred to.)

ACCUMULATORS FOR ELECTRIC CARRIAGES. Niblett. "Elec. Rev.," August 17.—An article describing recent improvements in accumulators for such vehicles.

ELECTRIC VEHICLES.—"Elec. Eng.," August 18.—Brief, illustrated descriptions of the "American" vehicles made by a company in Indianapolis.

Installations, Systems and Appliances.

INSTALLATIONS IN THE FRENCH ALPS.—"L'Eclairage Elec.," July 30.—Tables of statistics. There are sixty electric lighting installations, representing 4600 horse-power, of which 3300 are furnished by water power; forty-four use the continuous and twenty-one the alternating current, with two using tri-phase currents and the rest combinations of these. For the transmission of energy there are fifteen installations, representing 5500 horse-power, practically all of it being water power; seven use the continuous current and six the simple alternating current, one the bi-phase and one the tri-phase current.

ACCUMULATORS FOR LIGHTING AND TRACTION. Davenport. Lond. "Elec. Rev.," August 5.—Some brief comments on the recent paper by Rider (see "Digest" July 30; also below). It is claimed that the misuse is intentionally or unintentionally omitted in the paper; these misuses account for most of the prejudices which still exist against accumulators, and to these he calls attention; many of the bad effects caused by systematic overcharging might be obviated by the use of automatic switches. To get the best results care needs to be taken with the batteries equally as with a steam plant, and he believes many of the failures of batteries have been due to the culpable negligence of the engineers under whose supervision they were.

FRANKFORT.—Lond. "Elec. Eng.," August 5.—A short description of the central station.

OFFICE BUILDING PLANT.—"Amer. Elec.," August.—An illustrated description of the plant in the Cushman building, New York, in which steam is obtained from the central steam station in that city and used in steam engines to generate electrical energy which is used for lighting and elevator service, the exhaust steam being used for heating. See The Electrical World, July 30, 1898.

DETROIT MUNICIPAL PLANT.—"Elec. Eng.," August 18.—An abstract of the 1898 report of this municipal lighting plant, about which there has been much discussion; there is also an editorial discussion of it in the same issue. See The Electrical World, August 13, 1898.

MADRID.—"Sc. Am. Sup.," August 6.—An illustrated description from the Lond. "Engineer"of an alternating current plant erected by an English firm.

ACCUMULATORS IN LIGHTING AND TRACTION SYSTEMS. Rider. "El'ty," August 17.—A reprint of the paper noticed in the "Digest" July 30.

ALTERNATING CURRENT CONNECTIONS.—"Amer. Elec.," August.—Two full-page plates of diagrams, showing the connections in polyphase and simple alternating current systems.

Wires, Wiring and Conduits.

APPARATUS FOR DISTRIBUTING SYSTEMS.—Lond. "Elec. Rev.," August 5.—A brief, illustrated description of a new system of distributing apparatus, in which the main principle is its insulations, both between the circuits and between them and the ground; it is specially adapted to the 200 volts supply systems.

FUSES.—Lond. "Elec. Eng.," August 5.—An answer to a request to give the essentials of a good fuse to protect street mains from short circuits on consumers' premises; several sketches are given; also rough curves, showing the relation between the fusing current and the diameter, the fusing current and the length, and the difference between open and closed fuses.

HIGH-VOLTAGE TRANSMISSION LINE. Dailey. "Amer. Elec.," August.—Some practical hints concerning the erection of such lines.

INTERIOR WIRING. Knox. "Amer. Elec.," August.—A short article illustrating the methods of controlling lights and branches.

Electro-Physics and Magnetism.

CURRENT AT RUPTURE. Arons. "Wied. Ann.," December; abstracted in "L'Eclairage Elec.," July 30.—Instead of assuming, as is generally done in finding the equation of the current at rupture, that the E. M. F. is annulled or the resistance becomes suddenly infinite, it is more logical to suppose that this variation has a certain duration. On this basis he deduces some equations and applies them to two cases; in the first this duration is greater than the time constant of the circuit, and he then finds that the current decreases from its initial value to zero, and the E. M. F. increases from zero to a certain value (not clearly explained in the abstract, but presumably the product of the initial voltage and the time constant, divided by the difference between the duration and the time constant) and remains finite, its limit being larger the less the duration differs from the time constant. In the second case the duration is less than the time constant, and the current will then decrease from the initial value to zero, but the E. M. F. will increase indefinitely; in practice it will increase until it becomes sufficient to pierce the insulation. The effect of the duration is shown in a table of calculated values for a special case, the table being reproduced in the abstract.

MUTUAL EFFECT OF TWO SPARKS. Karoly. "Wied. Ann.," 62, p. 612; abstracted briefly in "L'Eclairage Elec.," July 30, and "Science Abstracts," July.—An illustrated description of a lecture experiment.

AIR UNDER POWERFUL ELECTRIC STRESS. Trowbridge. "Phil. Mag.," August.—A short article on the behavior of air and rarefied gases under powerful electric stress. He lately increased the number of his condensers to 120, thus obtaining an E. M. F. of 3,000,000 volts. The initial resistance of air under these circumstances is greatly reduced, and the curve representing the relation between spark length and voltage departs from a straight line beyond 1,200,000 volts, approaching the axis expressing the voltage; thus the extreme length of spark in air with 3,600,000 volts is 6.5 feet, whereas it should be 10 feet if the proportionality between spark length and voltage had been maintained. This departure from proportionality is due to the increased conducting power of air; a powerful brush discharge passes to the floor and walls; portions of the discharge are shunted through the surrounding air; with still higher voltages it is probable that the resistance of air would be of the order of metals. The initial resistance also of highly rarefied media diminishes in a similar way; thus a Crookes tube which resisted the passage of an 8-inch spark is brilliantly lighted by 3,000,000 volts; one discharge lasting a millionth of a second is sufficient to obtain a photograph of the bones of the hand. The electrostatic field in the neighborhood of the apparatus is extremely powerful; long sparks can be drawn from neighboring metallic masses. The behavior of air and rarefied gases with powerful electric stress is analogous to that of elastic bodies under mechanical stresses; the initial resistance of air steadily diminishes with powerful electric stresses, and under disruptive discharges sinks to 2 or 3 ohms; this leads to a rapid change of potential producing the electromagnetic impulses, which, we have reason to believe, are the source of the X-rays.

CONTACT RESISTANCE. Branly. Lond. "Elec.," August 5; abstracted from "Comptes Rendus," July 25.—A brief abstract of an Academy paper describing experiments with similar metals as distinguished from his former experiments with dissimilar metals. In the case of aluminum, iron and bismuth the resistance was low, if the discs forming the piles are placed on one another gently, but if dropped on each other with a slight shock and then subjected to the same pressure as before the value of the resistance increased enormously. No attempt is made to account for the phenomenon.

HALL EFFECT IN LIQUIDS. Everdingen. "Proc. Acad.," Amsterdam; abstracted briefly in Lond. "Elec.," August 5.—An important contribution to the discussion; he determined the theoretical value of the effect in a given electrolyte; the results in concrete cases do not agree with the experimental values obtained by Bagard.

GAMMA FUNCTION APPLIED TO AN ELECTROSTATIC PROBLEM. Jude. "Phil. Mag.," August.—Maxwell gives an equation for the distribution of electricity on a pair of freely charged spheres in contact, but, except when the spheres are equal, the results cannot be calculated by ordinary algebra; in the present short article, which is of a mathematical character, he shows that the results may be obtained by means of the gamma function.

ATMOSPHERIC ELECTRICITY. Chauveau. "L'Elec.," August 6.—An abstract of a French Physical Society paper on the diurnal variations of the atmospheric electricity; he gives the results of observations extending over several years at the meteorological bureau and on the Eiffel Tower.

ELECTRICITY AND LIFE. Solvay. "Bul. Acad. Roy. Belgique," No. 5; abstracted briefly in Lond. "Elec." August 5.—An announcement that two important organic syntheses have been obtained electrically; one is a sugar, which was made from the mixture of one volume of dry and pure carbonic acid and two volumes of hydrogen, contained in an ordinary Berthelot ozone tube, by the action of a brush discharge kept up for five hours; the process may be compared with that of the formation of sugar in plants under the influence of sunlight. The other product is urea, which is made from one volume of carbonic acid and two volumes of dry ammonia.

LUMINOUS EFFICIENCIES OF THE RARE OXIDES. Chatelier and Bondouard. "L'Eclairage Elec.," July 30.—An abstract of a French Academy paper discussing the numerous theories to explain for the great efficiency. They claim that each of the theories is in contradiction with direct observation, and that the ordinary laws of radiation suffice for accounting for the high luminous efficiency of the rarefied oxides at incandescence. In conclusion they say that the theory may be stated as follows: The hood is composed of a material of which the emissive power at the existing temperature is different for the different radiations. The good efficiency is due to the very great emissive power, in the neighborhood of unity for the blue, green and yellow rays and less for the red and much less for the infra red rays; the proportion of energy radiated as visible rays is therefore very great; however, the absolute value of the energy thus radiated in the luminous form is less than that which would be emitted by a black body at the same temperature.

EVIDENCE THAT ROENTGEN RAYS ARE ORDINARY LIGHT. Stoney. "Phil. Mag.," August.—A short article supplying an omission in his paper in the June number of that magazine and giving the following summary of the results arrived at in that paper: "Röntgen rays consist of two distinct undulations, which present themselves in succession. They are an irregular progression of independent pulses in the first part of their course—from the target upon which the cathode rays impinge up to the object which is being skiographed. Beyond that object, between it and the fluorescent screen, they are a different undulation. For, as proved in the June number of the magazine, the radiation from the target is the same *physical* (and not merely kinematical) event as the simultaneous advance over the same ground of trains of waves, some of long, others of short wave lengths. Since the resolution into these trains of waves is physical the trains advance independently of one another; so that if, by any contrivance, some of them can be stopped, the rest will be unaffected and will proceed. Now the flesh of the human hand is a contrivance of this kind; it is opaque to the wave lengths of all visible light and of much ultra-violet light, but allows waves that are below a certain limit of shortness to pass through it. Accordingly, the trains of sufficiently short wave lengths are the only physical constituents of the first undulation which can get past this obstacle; and are what produce, by their co-existence in the space beyond, that second part of the Röntgen undulation which lies between the object and the fluorescent screen."

DISTRIBUTION OF CHARGES IN GEISSLER TUBES. Riecke. "Wied. Ann.," 63, p. 220; abstracted briefly in "L'Eclairage Elec.," July 30.—He deduces formulas for calculating the voltages and charges along the length of a tube.

POTENTIAL GRADIENT IN GASES. Capstick. Lond. "Elec.," August 5; abstracted briefly from the "Proc. Roy. Soc.," No. 398.—When the pressure in the tube is a few millimeters there is a rapid flow of potential near each of the electrodes, with a more gentle fall in the space between. He made some experiments to find some connection between the cathode fall and other physical properties of the gas.

DISRUPTIVE DISCHARGE. Steinmetz. "Amer. Elec.," August.—A diagram giving the relation between the striking distance and the disruptive discharge for currents from an iron-clad alternator and a smooth-core alternator. The discharges were between the fine points of sewing needles; between balls, plates or rounded conductors the distance is very nearly the same for voltages above 100,000, but is very much less for low voltages; the discharge between needle points is said to be much more reliable for fairly low voltages than between balls, which is the reason why needles were used; temperature, moisture, etc., seem to have no noticeable effect on the striking distance between sharp points.

ROENTGEN LIGHT NOTES. Rollins. "Elec. Rev.," August 17.—In this continuation of his long serial he shows the fallacy of using the equivalent air spark as a measure of the degree of vacuum in a Röntgen tube; other data should accompany this statement; for instance, the striking distance will be different whether a static machine or induction coil is used, also with different types of induction coils; at the exhaustion required the resistance of the tube as measured by the equivalent spark in air is inversely proportional to the voltage; the lower the voltage the higher the vacuum must be to produce an equal radiation. He shows that covering the target with aluminum gives no better results than platinum. The diaphragm for sharpening the shadows cast he now makes of glass half an inch thick instead of metal, as usual. Instead of using the water to cool the target it is sufficient for moderate currents to use a copper stem attached to the target to carry off the heat.

Electro-Chemistry and Batteries.

DEPENDENCE OF THE E. M. F. ON THERMO-ELECTRIC DATA. Platner. "Elektrochem. Zeit.," Aug.—The first part of an article on the dependence of the E. M. F. of a galvanic cell on the thermo-electric data. The dependence of the one on the other may be calculated from Helmholtz's well-known formula; this contains a term which may be either negative or positive, and which depends on the increase of temperature; relatively little seems to be known about this term. He discusses the nature of this source of energy; it has been suggested that it was due to the Peltier effect, but he shows that this does not explain it, as in some cells the quantity is positive. Moreover, it is not quite correct, as assumed in the Helmholtz formula, that the thermic equivalent for the chemical process is independent of the temperature. All this shows that our knowledge of the conversion from chemical into electrical energy is still quite incomplete. He then begins the description of researches which he made to elucidate this point; to measure the temperature exactly the metal of the thermometer was used as one of the electrodes. The results so far seem to lead to the assumption that there is no real difference between galvanic cells and the so-called thermopiles, and that there is no necessity to assume two different kinds of processes of generation. He promises to give the results of his investigations in the next portion of the article.

ELECTROLYTIC THEORIES. Edser. Lond. "Elec. Eng.," August 5.—In this continuation of his serial he discusses electrolytic refining of metals, the Thompson law for calculating the E. M. F. of a cell and the distinction between reversible and irreversible cells.

CHLORINE AND CHLORATE. Hargreaves. "Zeit. f. Elektrochemie," August.—A reply to a recent article by Lunge; it is theoretical in character.

OZONE. Andreoli. Lond. "Elec. Rev.," August 5.—A brief reply to the article by Kershaw noticed in the "Digest" last week. He claims that the data concerning the yield of the Otto and the Yarnold ozonizers are questionable, and that the figures obtained were due to defective and inaccurate methods in the determination of the ozone produced; the results obtained by such an analysis depend greatly on the methods employed, and errors of 50 to 80 per cent. are easily made; he personally challenges the accuracy of the figures given. He claims that the calculations of Kershaw concerning the comparative action of the various bleaching agents have no value whatever, for the reason that ozone is not applied like the other bleaching material. In a previous paper he said that decoloration by ozone alone is a myth.

TREATMENT OF ARGENTIFEROUS LEAD. Hesse. Lond. "Engineering," Aug. 5.—A brief extract of an article from a German journal in which he states that experimental work with an 8-hp installation has been successful and the estimates show that the process can be worked to yield a large profit. The zinc-silver alloy used contains 10 to 12 per cent. of silver; the solution is a neutral or slightly basic zinc sulphate; the deposit of zinc was satisfactory when the electrolyte was free from impurities, but only then; purity of the electrolyte is the principal factor for obtaining proper deposit of zinc; the electrolyte was systematically aerated to precipitate metallic impurities as oxides; the silver passed into the anode slimes. He doubts whether the electrolytic separation of zinc is profitable except in the case of zinc and silver alloys.

UTILITY OF PRIMARY BATTERIES.—Lond. "Elec.," August 5.—A long editorial in defense of the primary battery. The electric light did not lead to the abolition of candles, and similarly the dynamo does not necessarily lead to the abolition of the primary battery, for which it is claimed that there is a legitimate place which is better filled by it than by any other generator. Considerable advance could be made if local action and polarization could be minimized or eliminated, or if it were possible to use cheaper materials; there is nothing inherently impossible or even improbable in a well-organized company being run successfully on the merits of a new primary battery; it is not claimed, however, that the battery to do this has yet been invented; it is thought, however, that the new one which is being at present brought out in England (the Rowbotham, see "Digest" last week) possesses in many respects the elements of commercial success. Local action is said to be prevented when the cell is not in use by the fact that the water is kept in circulation through the space containing the iron; when running, the current generated in the porous tubes forces the acid into the outer chamber, but when there is no current there is no pressure, and every trace of acid is then flushed out by the water. According to Prof. Thompson there is no polarization when in use and no local action when lying idle. It appears that the initial outlay is considerably below the cost of a small steam or gas driven plant, and according to the tests the cost of attendance will be much less than for the usual isolated plant; the estimated cost will be higher when only small quantities of the materials are used. The success of a new battery does not rest on whether a current can be generated for 12 cents or 37 cents per kilowatt hour, as there is a field at even the latter rate, but the success must depend entirely on whether it can be installed and used continually without inconvenience from frequent repairs, without bad odors or falling voltage.

TRANSITION CELL. Cohen. "Zeit. f. Phys. Chem.;" noticed briefly in the Lond. "Elec. Eng.," August 5.—He describes an electric cell in which the E. M. F. is produced by means of electrodes placed in saturated solutions of the two forms of a compound capable of undergoing a transition change; also an element in which the temperature coefficient changes abruptly at the transition temperature; no further information is given in the abstract. Another class of cells is of the following type: "Electrode reversible with respect to the anion-saturated solution in presence of stable solid phase—electrode reversible with respect to the cation."

ARRANGEMENT OF AN ELECTROPLATING PLANT. Ulke. "Eng. and Min. Jour.," August 6.—A short, illustrated description of the arrangement of a model electroplating and polishing plant of the usual capacity, showing also how the various connections should be made.

RECOVERY OF GOLD FROM CYANIDE SOLUTIONS. Cowper-Coles. "Eng. and Min. Jour.," August 6.—A long abstract of a paper noticed in the "Digest" June 25, in which he recommends the use of an aluminum cathode.

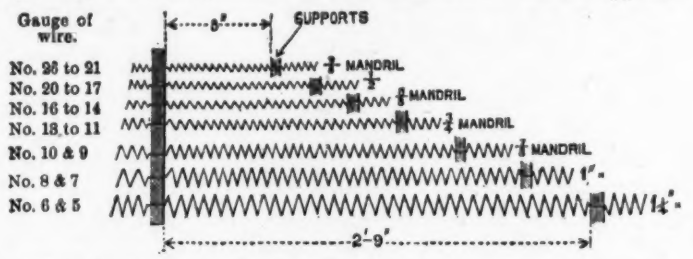
ZINC EXTRACTION PROCESS. Threlfall. "El'ty," August 17.—A reprint of the article noticed in the "Digest" August 13.

Units, Measurements and Instruments.

EFFICIENCY MEASUREMENTS OF DYNAMOS. Bunet. Lond. "Elec. Rev.," August 5; reprinted in "El'ty" (N. Y.) August 17.—A long abstract of an article from the "Rev. Phys. et Chemie." He describes various methods of measuring the efficiency and discusses their relative advantages and disadvantages; he divides them into two classes, one in which the energy consumed and delivered is measured, and the other in which either of these and the losses are measured; the methods themselves are well known. He discusses the question of the relative efficiencies of the same machine as a dynamo and as a wattmeter, concluding that if in each case it is run so that the induced E. M. F. is the same, with the same currents through the armature and magnets, then the speed and magnetic flux will also be the same; the resistance losses and those due to friction, hysteresis and eddy currents will also be the same; formulas for the efficiency of the dynamos and for the motor are then given and are very nearly equal; he assumes the lead of the brushes to be the same and that the armature reaction requires the same compensating ampere turns and excitation, claiming that this is borne out by his experience; editorially, preference is given to adjusting the exciting currents until the speed is the same, when the motor is supplied with current with a terminal voltage equal to the terminal voltage of the dynamo plus twice the calculated drop in volts in the armature. It is often held that the Swinburne method, in which the losses are measured, gives too high an efficiency, but Bunet gives figures of tests by the Swinburne and other methods which show that this is not so to any appreciable extent; these figures are reproduced in the abstract. The well-known Hopkinson method is next discussed; instead of the dynamometer for measuring the lost power, the method has been modified so that the energy required to make up the losses is supplied by a dynamo which is connected either in parallel or in series with the generator under test; in the former case it must supply current at the same voltage, and in the latter case it must carry the main current in its armature; Bunet recommends the former because it is easier to regulate the speed of the machines. The proper way of deducing the efficiency of each of the machines from the combined efficiency found from this test has given rise to much discussion; he states that if the square root of the combined efficiency is taken as the efficiency of each machine, an error of as much as 2 per cent. may be made; he makes recommendations concerning the best conditions; but it is thought that there is no appreciable error in assuming the hysteresis, eddy current and friction losses to be the same in both; he gives an equation for the efficiency when the current in the motor armature is greater than that in the generator armature; editorially, it is preferred to calculate the resistance losses, deduct them and allot half the remainder to each machine as the sum of the friction and core losses, after which the efficiency is calculated like for the Swinburne method. When the auxiliary dynamo is connected in series with the machines under test the best conditions are those which make the mean of the voltage at the dynamo and motor armatures equal to the normal voltage; it is preferable to separately excite the magnets in this test, reducing the excitation of the dynamo and increasing that the motor so that the machines may run at normal speed; the currents in both armatures are then the same, as are also the friction and other losses. It is thought that the Swinburne and Hopkinson methods are far ahead of any others in accuracy, and the choice between them is determined by which is the more convenient in a particular case: if only one machine is to be tested the Swinburne method is the best; the resistance should be measured hot; the Hopkinson method is preferable where two similar machines are available; no difficulty was found in making the test under good conditions with the auxiliary dynamo in series; so little difference was found in the two methods that either may be used, depending on the auxiliary dynamo at one's disposal.

COMPARISON OF LOW RESISTANCES. Callendar. Lond. "Elec.," August 5.—A communication on such comparisons with the potentiometer, with special reference to the recent remarks of Fisher (see "Digest," August 6). The potentiometer method is most at a disadvantage in the time required; with very low resistances large testing currents are required, which are seldom found where they are wanted; for comparing unequal resistances he finds the Nalder instrument more convenient than Crompton's. The best method of comparing two unequal resistances by means of the Crompton potentiometer is to shunt the larger of the two with a finely subdivided ratio box or slide of relatively high resistance and to find by means of the ratio slide what fraction of the voltage on the larger resistance is equal to that on the smaller; the potentiometer is merely used as a test of equality and the accuracy of the measurement depends on the accuracy of the reading of the balance point on the slide; this method reduces the time of observation to a minimum and greatly diminishes the trouble arising from variations in the testing current; the advantage is that only one balance point has to be found for the comparison of two resistances; in the majority of cases, however, it is much simpler and better to discard the potentiometer with its two separate sources of steady currents and to use only the ratio slide by the bridge method, so as to be entirely independent of batteries and steady currents. For accurate work a great advantage of the bridge method as compared with the potentiometer method, in addition to its simplicity and independence of the steadiness of the current, lies in the superior ease with which the error arising from accidental thermo-electric effects may be eliminated; the potentiometer cannot be used with satisfaction for comparing resistances of the order of 10 microhms, without taking into consideration the thermo-electric effects; it is advisable, then, to reduce the current to about one-hundredth of its normal by means of an outside resistance; also use a different galvanometer than that usually employed; the small differences of potential due to temperature cannot be neglected, but the errors are eliminated by using the bridge method in the usual manner.

METALLIC RESISTANCES. Scott. Lond. "Elec. Rev.," August 5.—The conclusion of his article (see "Digest," August 13). Expanded metal made of sheet wrought iron may also be used, and is preferable to wire netting in some cases, as it is stiffer; it will dissipate energy at the rate of 200 watts per pound weight; a suitable size is 8 feet long, 18 inches wide, with a quarter-inch mesh; the carrying capacity, resistance, weight and price are given in a table; for a thickness of No. 16 B. W. G. the carrying capacity per inch of width is 95 amperes, the resistance of a piece 1 inch wide and 1 foot long is 0.0025 ohms; the weight of this piece is 3.5 ounce, and the approximate price per square yard is 63 cents. Expanded metal also affords an excellent protection to resistances built of wire spirals. For very large currents, as those used for electrolytic work, it is generally more convenient to use copper, as its smaller cross section facilitates the mechanical construction. Field coil regulators are often made with wire wound on a sla centre and fitted with sliding contacts; one of these is illustrated. Ordinary wire coil resistances are usually fixed in a vertical position to get rid of the sag, but for keeping cool the horizontal position is the best; the proper distances between the supports is often neglected; the best practice in this direction is shown approxi-



mately in the accompanying diagram, of which no further explanation is given (the gauge numbers evidently refer the B. W. G.). It is a mistake to skimp the ironwork in a resistance frame, as it is a great heat dissipator, iron, for instance, absorbing about 2000 foot pounds of heat units to raise one pound from zero to 100° C. A frame which can be built up without the necessity of making patterns is illustrated, it being made of T-iron bent in the form of a rectangle. Siemens & Co. inclose wire spirals in iron tubes filled in with fine sand; the General Electric Company's (American) and the Carpenter resistances are described.

CALCULATION OF THE JOINT RESISTANCE OF CONDUCTORS. Ross. "West. Elec.," August 13.—For calculating the joint resistance (in parallel) he gives the following rule: Add the reciprocals of the resistances and then take the reciprocal of the fraction thus obtained. (This is nothing more than the well-known rule to add their conductivities and then change the conductivity into resistance.)

Telegraphy, Telephony and Signals.

TELEGRAPHIC LIGHTNING ARRESTERS. Voisenat. "Ann. Télégraphiques," January-February; abstracted by Pierard in "L'Elec.," July 30.—After a discussion of the work of Lodge in this direction he gives the experiences which have been had with the various types of arresters. His conclusions are that telegraphic lines should be considered as being exposed to two kinds of currents very different from each other in their method of action—high-frequency currents and currents which vary relatively slowly; these two currents can succeed each other actively and even act simultaneously, thus producing very varied effects. The transmission of the high frequency currents is hindered by the impedance of

the conductors, and the discharges, being oscillary in character, are probably dangerous only in a very limited district near the point struck; the currents, which vary slowly, are subject to Ohm's law; they have their effect on the whole length of lines and on the apparatus connected to them; it is thought that there is no other means of avoiding their evil effects except by some means of breaking the circuit. Fuse wires and discharge arresters are, therefore, two indispensable pieces of apparatus to protect the lines. Metallic circuits with quite symmetrical conductors, if there is absolutely no communication with the earth or a possibility of an accidental ground, have no need of protection against permanent currents, and fuses are therefore superfluous, but the discharge arresters are indispensable. According to the principles which he enunciates interior installations should be protected by a series of protectors on the lines themselves outside of the building, the only one inside being the fusible wire; vacuum protectors are of no particular use except on conductors having no connection with the earth. The exterior and interior connections are then briefly described, the latter depending upon whether the apparatus to be protected is of great value or not, and on the liability to lightning discharges; for the former it is sufficient to use a good discharge arrester, a useful precaution being to run the earth wire along the same path as the line wire, and in case of single-wire circuits to attach the ground wires to the arrester; when great protection is required it is well to use two or three successive arresters separated by one or two pairs of coils; on a metallic circuit each conductor should be thus protected; in a single-wire circuit it is preferab to have the interior wiring a metallic circuit, making the ground connections through the arrester. If the wires pass near a high-tension circuit the fusible cut-out should always be added.

WIRELESS TELEGRAPHY AND COLLISIONS AT SEA. Branly. "L'Elec.," August 6.—A short Academy paper. In applying the wireless system of telegraphy to ships at sea the difficulty arises that the transmitter should not operate the receiver on the same vessel; he has shown in a previous paper that the receiver may be protected by being completely enveloped in metal; a device might be arranged so that the receiver is automatically covered when the circuit of the transmitter is closed, and vice versa; not only the coherer, but the whole circuit, must be included. Such a system should also indicate the direction of the other vessel, and whether it is approaching or receding; the receiver might be placed in a metallic cage open only on one side and capable of being turned; the direction in which this opening points when the bell rings will indicate approximately the direction from which the electric waves come. Experiments analogous to those described in his paper read July 4, he thinks, would surely lead to the use of covers, which, by a comparison of the effects, will enable one to determine whether the distance was increasing or diminishing.

LONG-SPAN CABLE. Preller. Lond. "Engineering," August 5.—A brief description, with data, of a long span across the Walen Lake in Switzerland, which is the longest span in Europe. The span is 1.56 miles, one end being 1180 feet above the lake and the other end 426; the greatest dip is 590 feet. The original wire broke during a storm and a subsequent one broke from a deposit of snow; this was replaced by a cable of three zinc-coated, 3-mm steel wires, weighing 462 tons and having a breaking strain of 3330 pounds; the ends are suspended from a movable insulating drum held by a swivel, so that vertical and horizontal variations take place in the links, and not in the cable; the total cost, including re-erection, was $100, or $40 per km, while the average cost of an ordinary double 2-mm copper wire telephone line, including poles and re-erection, is about $90 per km, and $20 per km for every additional two wires. Since this was written the cable has broken again; during violent gusts of wind it is suddenly lifted, after which it falls, producing a wave-like motion, the vibrations being transmitted from the upper toward the lower end, like in the cracking of a whip, and they become so great that the cable is fractured at the lower end; the re-erection of the cable will necessitate its being suspended from supports placed at equal heights at both ends.

PROTECTION OF RAILWAY TRAFFIC.—Lond. "Elec. Rev.," August 5.—A brief description of the Chauvin and Baulan system, which was noticed in the "Digest" May 28.

TELEPHONE SYSTEM OF THE UNITED KINGDOM. Raphael. Lond. "Elec.," August 5.—The concluding article of his long series (see "Digest," June 11).

PHONOPORE PATENT EXPIRING.—Lond. "Elec.," August 5.—A note stating that the English patent 10,990 to Langdon Davies, 1884, for his phonopore, expires August 6.

FIRE ALARM SYSTEM.—"Elec. Eng.," August 18.—A brief description of the motor-generator system used on the Chicago fire alarm circuits.

AMERICAN TELEPHONE PRACTICE. Miller. "Amer. Elec.," August.—An illustrated description of self-restoring switch drops as used in this country.

PITTSBURG. Fairchild. "Elec. Eng.," August 18.—An illustrated description of the Bell plant in that city.

TELEGRAPHY AT THE OMAHA EXHIBITION.—"Wes Elec.," August 13.—Illustrated descriptions of some of the exhibits.

Miscellaneous.

LITHIN; A NEW INSULATING MATERIAL.—"Elektrochem. Zeit.," August.—The tabulated results of tests made by the Reichsanstalt of this new insulating material, which is intended to be used in place of hard rubber or fibre wherever these materials are no longer suitable. One of the chief properties is its independence of the effect of moisture, a plate, for instance, immersed seventy-two hours in water increased in weight only 0.41 per cent. Both insulation and breaking-down tests were made, the former before and after immersion in water. A plate about 1.25 mm thick was pierced with 9300 volts, while a plate about 1 cm thick withstood 26,000 volts for fifteen minutes without change.

ELECTRICITY AND FIRE DAMP. Couriot and Meunier. "L'Elec.," July 30 and August 6.—A reprint of the complete Academy paper, which was noticed in the "Digest" June 11.

CROMPTON & CO.'S WORKS.—Lond. "Elec.," "Elec Eng." and "Elec. Rev.," August 5.—A well-illustrated description of the new works of that company at Chelmsford.

ABSTRACTS.—The "Elec. Rev." frequently reprints abstracts from "Science Abstracts," the issue of August 17 containing a number of these.

Book Review.

LA TRACTION ELECTRIQUE SUR VOIES FERREES. By Andre Blondel and F. Paul-Dubois. Published by Librairie Polytechnique Baudry et Cie., Paris, France. Two volumes, 1700 pages, 1014 illustrations. Price, 50 francs.

The names of the authors of this work are a sufficient guarantee of its reliability, and its completeness is well indicated by the number of pages. The work is very thoroughly prepared, a short chapter given to the history, followed by descriptions of suitable roadways, rolling stock, motors, electric locomotives, etc. The second volume contains chapters on the action of direct current traction motors, regulation of the speed, the braking of electric vehicles, alternating current systems, etc. An almost invaluable part of the work is the complete classified bibliography, the work itself being rendered much more valuable by a most thorough alphabetical index with many cross references carefully worked out.

Exhibits at the Convention of the Ohio Electric Light Association.

THE BRADFORD BELTING COMPANY, Cincinnati, Ohio, was ably represented by Mr. George C. Kunz.

MR. H. E. ADAMS represented the Illinois Electric Company, Chicago. This is a comparatively new house, but its managers are experienced and know how to get business and conduct it.

MR. EMIL C. SCHMIDT, superintendent of the Sandusky Lighting Company and president-elect of the Ohio Electric Light Association, made for himself a reputation as being a master in the art of entertaining a crowd. His careful attention to the wants of the visitors, especially the ladies of the party, won to him many friends. Those who know Mr. Schmidt best predict some excellent executive work in the interest of the association during the coming year.

MR. W. D. PACKARD, of the New York & Ohio Company, Warren, Ohio, made his appearance at the convention on Friday. Mr. Packard has a host of friends in the electrical fraternity, and is a gentleman held in high regard by all who have the pleasure of his acquaintance. He reports that Packard lamps and transformers are growing in favor, and that his company's facilities are fully utilized in the production of these well-known goods. Besides Mr. Packard, the company was also represented by Mr. D. W. Low and Mr. Robert E. Gorton.

THE ELECTRIC APPLIANCE COMPANY, Chicago, had a live representative in the person of Mr. C. J. Wells. In addition to his social and business qualities Mr. Wells enjoys the distinction of being the only electrical man on the road that writes his name and address backwards and upside down, and not as ordinary beings subscribe themselves. However, when he talks Electric Appliance Company business it is not necessary to stand on one's head to understand him.

THE JANDUS ELECTRIC COMPANY, Cleveland, Ohio, had two of its inclosed arc lamps on exhibition in the hotel corridor. The steadiness of the light and the graceful outlines of the lamps themselves were prominent outwardly visible features, while the constructional details of the lamp, ordinarily invisible, were carefully explained by the company's representative. He was aided in this task by the exhibition of samples of the various parts which combine to make a completed lamp.

MR. CARYL D. HASKINS is a pet of the Ohio electric light men. He met with a very hearty reception on his arrival at the hotel on Friday morning, and it was evident by the questions plied to him by groups of members that the subject with which he is so familiar—meters—was a live one to them all. Mr. Haskins evidently reciprocates the feeling of regard, too, or he would not have come all the way from Boston to read a paper, and then rush back home as soon as the paper was read and discussed.

MR. JOSEPH M. HILL, of Chicago, the Western representative of the Bryan-Marsh Company, New York, was in attendance in the interest of Imperial incandescent lamps. Mr. Hill is known to every station man in the West, and he never fails to meet with a hearty reception at conventions. He is a very popular gentleman, and his personality is brimful of good humor. Mr. Hill did not have with him a lamp exhibit, but his vocal organs supplied this deficiency. His disquisitions on Imperial lamps are quite as effective in a business way as a display of the lamps themselves would be.

MESSRS. JAMES T. PARTRIDGE and J. S. Speer, of the Partridge Carbon

Company, Sandusky, Ohio, spent considerable time around the hotel conversing with the members and making new friends among them. The Partridge Company has succeeded in producing an electric light carbon for inclosed arc lamps which is claimed to be in all respects equal to the best imported carbons. These carbons were used in the lamps in the General Electric Company's exhibit, and they there "spoke" for themselves. The steadiness and purity of the light were noticeable. The Partridge Carbon Company's motor-brush business is steadily increasing. Several times the company has outgrown its factory facilities and enlarged its plant in consequence, and now it finds itself again in a like position. It recently filled an order for 200,000 carbons for one of its Eastern agencies.

THE WARREN ELECTRIC MANUFACTURING COMPANY, Sandusky, Ohio, occupied a room at the hotel in which it made an interesting display of samples of apparatus. The exhibit consisted of a Scheefer recording wattmeter connected up with a bank of six Shelby incandescent lamps. In this combination a small Diamond transformer was used, the primary being connected to the house circuit, 104 volts. The various component parts of the Warren alternator were also displayed on a large table. These included armature coils, field coils, laminations, etc. There was also a 75-100 kilowatt exciter, exemplifying the type of machine used in connection with the Warren alternator. The house circuit was supplied with current on the occasion of the convention from a Warren alternator at the Sandusky Lighting Company's station. The steadiness of the light in the hotel was perfect as far as the eye could judge. A plentiful supply of literature, pointing out the merits of the Warren apparatus, was distributed by Mr. C. P. Riegger, who had charge of the exhibit. Mr. C. C. Warren, president of the Warren Company; Mr. C. F. Mack, treasurer, and Mr. Frank Warren, were about the hotel much of the time entertaining the members, and at the same time, very naturally, dropping a good word now and then for Warren alternators. The Warren Company had another interesting feature in connection with its exhibit. It consisted of a sign board placed overhead on one side of the skylight well, near the hotel office, and was a conspicuously brilliant object to all who entered. On the sign the words "Warren Alternator" were wrought in Shelby incandescent 16-cp lamps. This brilliant reminder very naturally produced a strong impression upon the mind of the beholder.

THE GENERAL ELECTRIC COMPANY made a very creditable exhibit, which was in charge of Mr. W. J. Hanley, of the Cincinnati office. On a long table in a special parlor were shown an automatic motor starting rheostat, with overload circuit breaker; two alternating current fan motors, type U. I.; one direct current stationary motor, type C. A., of 1 horse-power; a Thomson alternating current voltmeter; a lamp testing portable wattmeter; a 2500-watt wattmeter and an inclined coil ammeter. Suspended from the ceiling was a single globe alternating arc lamp which gave a very clear and steady light. The feature of the exhibit was the miniature inclosed arc lamp, which measures only 15 inches over all. The illuminating power of this lamp and the current consumed are much less than in the standard lamp, hence it is possible to divide the total amount of light and secure better illumination for the same cost. The lamp is designed for 110-volt direct current circuits, but an adjustable resistance is provided whereby it may be adapted to any line voltage from 100 to 120. It takes two and one-half amperes, but a loop in the magnet coil permits an adjustment for three amperes. It burns from forty to forty-five hours with standard current—two and one-half amperes—and operates at from seventy-three to seventy-five volts at the arc. The carbon is fed through a brass tube, which extends through the centre of the magnet coil, the double cam clutch which operates directly upon the carbon being a remarkably simple piece of mechanism. No outer globe is used on this lamp, a porcelain shade aiding in the diffusion of the light. The single globe alternating current lamp above referred to is also provided with a porcelain shade. It operates at 60 or 125 cycles, taking six amperes, at 104 volts, and is adjustable for 120 volts on the line. The length over all is 23½ inches, and the life is 80 to 100 hours. The reflector is designed with the view of obtaining the best distribution possible with a single-globe lamp. The lower frame is of small dimensions, which feature is an advantage, since the intense light tends to cast dark shadows. It is of narrow rectangular section with the thin side toward the light. This type of lamp is made for both alternating and direct current circuits. The direct current C. A. motor exhibited was designed to take seven to eight amperes at 115 volts, running at a speed of 1000 r. p. m. The two alternating fan motors, both of which were in operation, ran on 125 cycles, 104 volts. One was 12-inch and the other 14-inch. The Thomson alternating voltmeter was a two-coil instrument without permanent magnets. The 2500-watt instrument was of the well-known inclined coil type. Mr. H. W. Hillman, of the lamp department of the General Electric Company's Schenectady works, was also present, and was particular in describing the features and advantages of the lamps exhibited. The burning single globe alternating lamp was furnished with the new carbon of the Partridge Carbon Company, Sandusky, which is claimed to be in every respect equal to the best foreign carbon used in inclosed arc lamps. Among other representatives from the General Electric Company's Cincinnati office were Messrs. F. A. Kelley and W. F. Hayes.

The Modern Round House Turntable.

The economies of railway management do not end with the adoption of the high pressure compound locomotive, or the hundred other contrivances which have been born of necessity, but go on and on, always finding a way to eliminate here or there an unnecessary expenditure.

An Electrically Driven Turntable.

The latest economical development is adaptation of the electric motor to turntables, called the turntable "donkey." The simplicity of the device and the method of operating it are plainly evidenced in the illustrations.

It is the product of the Westinghouse Electric & Manufacturing Company, and consists of its "series reversible" type "F" 10-hp motor, mounted within a heavy cast-iron frame, having a traction wheel which rests upon the rail of the turntable pit. Power is transmitted to this wheel through double reduction gears. The "donkey" frame is connected by draw bar and pin to one end of the turntable at the side, sufficient traction for the driving wheel being secured through the weight of the machine, which is 3700 pounds. Wires are run from the "donkey" to a small platform, located at one side of the centre of the turntable, or other convenient place, at which point is installed a controlling rheostat. By means of this controller the "donkey" may be operated in either direction at will by simply moving a single lever to one or the other side of a neutral point. Current, which may be supplied from the shop lighting or other convenient circuits and may be either alternating or direct and of any standard voltage, is supplied by wires brought to a suitable contact overhead and then led to the controller.

As no changes in the turntable are required for installing the turntable "donkey," the connections between the frame of the latter and the turntable girder being very simple, the cost of installation is low. As compared with the steam operated turntable it is apparent, even to the layman, that electrical power has the advantage, as it is a well recognized fact that the small portable boiler and engine are extremely wasteful of fuel, besides being a source of danger and requiring constant attention.

The comparison with turntables operated by push poles is no less interesting. In one of the installations, located at an important division point, it was necessary to turn 176 engines each twenty-four hours, or about seven per hour. Previous to installing this "donkey," push poles were used, requiring the services of four men, and the operation was a slow one at best. Now, one man does the work in a much shorter time. With turntable "light" the "donkey" will make a complete revolution in thirty seconds, while with a ten-wheel loco-

motive on the table, weighing, with tender, 100 tons, a complete revolution is made in forty-five seconds. This gives therefore the following summary:

Engines turned per day	176
Men required	4
Average time per engine	5 min.
Total time of one man per engine	20 "
Total time for 176 engines	59 hrs.
Total time for 176 engines, with electric donkey	24 "
Time saved	35 "
35 hours at 12½c., amount saved per day	$4.37

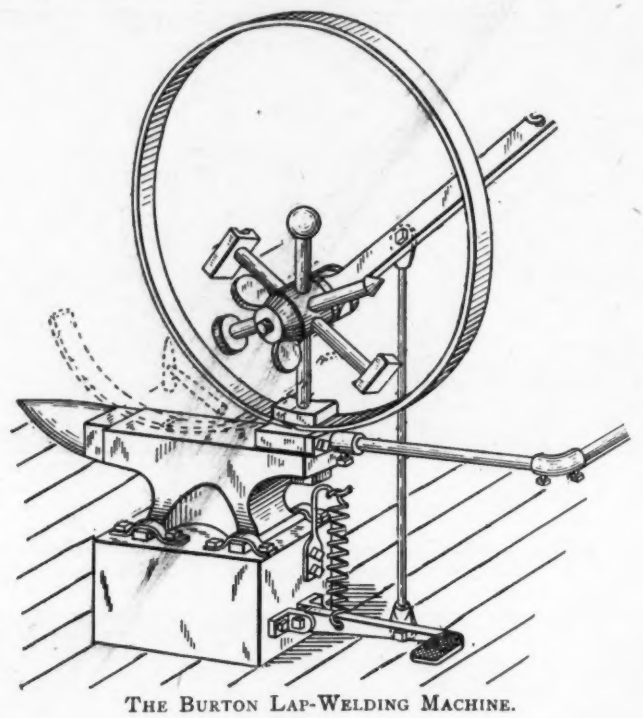
The above calculations assume that the men are employed in wiping engines while not employed in operating the turntable; otherwise the comparison would be still more favorable to electrical operation.

The assumption of five minutes per man on the average is conservative. It is plain that the thirty-five hours saved would supply two day and two night men as wipers on shifts of eight hours each.

It is stated that actual tests have shown that the average power consumed by the electric "donkey" is the equivalent of one-half horse-power hour per engine turned. Assuming 6 pounds of coal per horse-power hour, with coal at $2 per ton, the cost of fuel for turning each locomotive would be 3-10 cent or 53 cents for 176 locomotives.

An Electric Lap-Welding Machine.

A handy machine for use in iron works of almost any variety or magnitude from a blacksmith or bicycle shop to a Bessemer rolling mill is the lap welding, forging and brazing machine lately brought out by the Burton Electric Smelting Company, Boston, Mass. This machine, which is shown in the accompanying illustration, is capable of making a lap weld on an ordinary anvil in direct view of the workman. The piece to be welded rests on an electrode or contact block mounted on the anvil, and connected with one terminal of the source of current, the other terminal being attached to an arm pivoted at some point overhead and capable of being depressed by pressure on a foot lever. As soon as the required heat is obtained the foot lever may be released, and the weld completed by hammer blows with the anvil as a support. The upper terminal



THE BURTON LAP-WELDING MACHINE.

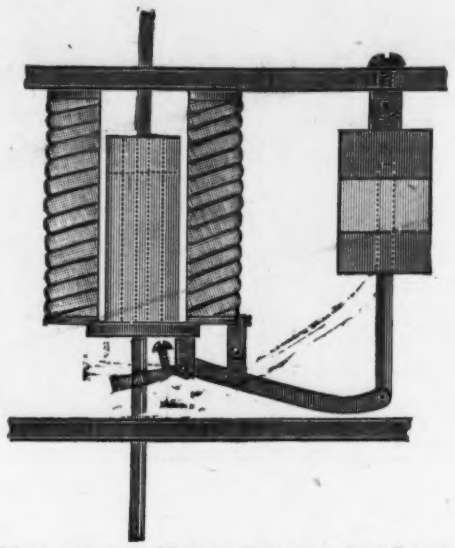
or electrode is fitted much after the style of a lathe turret with contacts of different shape for use on welds of different styles, the various contacts radiating from a hub attached to the pivoted arm.

The advantages of such an equipment are readily recognized from the improved results already obtained with electric butt-welding machines over methods using charcoal or even gas. These advantages are the cleanliness, the readily adjustable heat, the reduction of scale and the generation of heat while the welding process is being effected instead of before.

Mr. George D. Burton and his associates of the Burton Electric Smelting Company are well known already for their work in the design of apparatus for electric heating of metals, the Burton electric forge being quite widely used by prominent concerns the country over. The Burton furnace for ore refining and smelting has also been put on the market, so that the new welding machine is not an experiment on the part of inexperienced designers. A special direct current dynamo of low voltage and large ampere capacity is on the market by the same company for use with this machine, where other sources of current supply are not available.

Inclosed Arc Lamps for Constant Potential Circuits.

A line of lamps for direct current constant potential circuits has been put on the market by the Morris Inclosed Arc Lamp Company, Chester, Pa. The central parts of the operating mechanism of this lamp appear in the accompanying illustration, which shows the one central solenoid controlling the clutch and the dash pot, which prevents the movement of the former from becoming too sudden for satisfactory working. The core of the solenoid, which is series wound, carries the clutch ring, lowering the latter down as the arc increases in length, thereby cutting down the current, until tripped by striking the frame. Easy access for trimming is obtained by removing the outer globe,



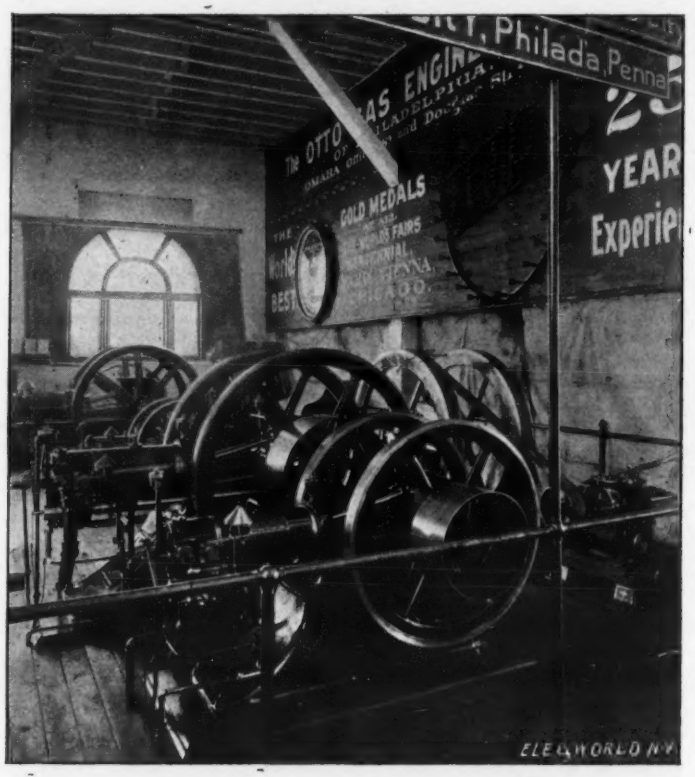
MECHANISM OF MORRIS INCLOSED ARC LAMP.

which is attached by spring catches, raising the upper carbon and lifting out the inner inclosing globe, which may then be cleaned and replaced with ease. The lamps are wound for 110 volts, unless otherwise specified.

Electrical Exhibits at the Trans-Mississippi Exposition—II.*

GAS ENGINE EXHIBITS.

The Otto Gas Engine Works, of Philadelphia, show several engines, all of which are running, and some of which are carrying loads. One drives a marine pump and another works a 10-hp dynamo for lighting the exhibit and a large electrical sign. The engines govern on the "hit or miss" principle, the oil be-

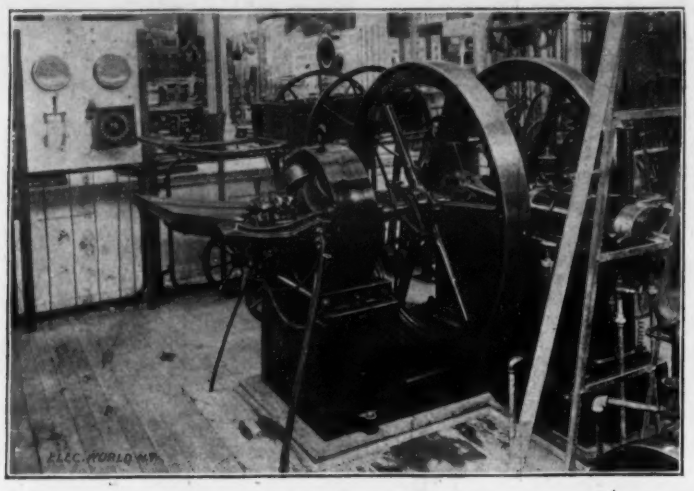


SAMPLE PRODUCTS OF THE OTTO GAS ENGINE WORKS.

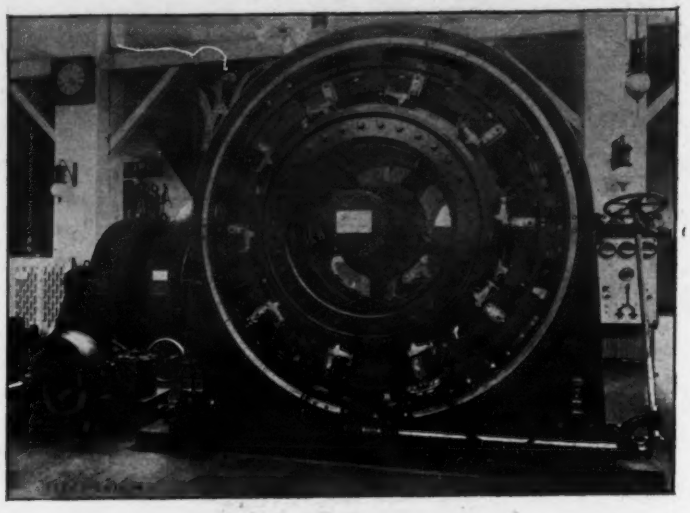
ing taken into the cylinder by gravity feed through a needle point valve which is actuated only when the speed is below the governing limit. Electrical ignition is used entirely. The exhibit is in charge of Mr. J. W. Marshall, the general Western agent of the company, with headquarters at Omaha.

* For other exhibits see THE ELECTRICAL WORLD, July 9, 1898.

FAIRBANKS, MORSE & CO. show a gas engine coupled by a link coupling to a four-pole generator made by the Commercial Electric Company, of Indianapolis. The interesting features of this make of engine are as follows: The governor is a shaft governor operating a hook, which, when the speed is above the critical value, hooks the whole valve gear in a position such that the exhaust valve is open, where it remains until the engine slows down to a speed below the critical value. This does away with the compression and following expansion of a new charge of air every idle cycle common to most hit or miss governors, the piston running freely in the cylinder between active cycles. The starting gear of this engine is also of interest. A small hand pump is arranged to be partially filled with gasoline, so that when operated it pumps a gasoline vapor into the cylinder. A parlor match is inserted in a plug in the cylinder casting, and, with the crank at the proper angle, the match is struck within the cylinder, exploding the charge pumped in by hand and thereby starting the engine. Beside the engines mentioned above, there are shown at the exposition one 4-hp engine geared to a pump, and one 12-hp engine driving a hoist. The latter is arranged to run normally at a low speed, the governor being under the operator's control in such a way that the speed can be raised at will to any point below an upper limit fixed by the mechanism.



A Direct-Coupled Gas Engine by Fairbanks, Morse & Co.

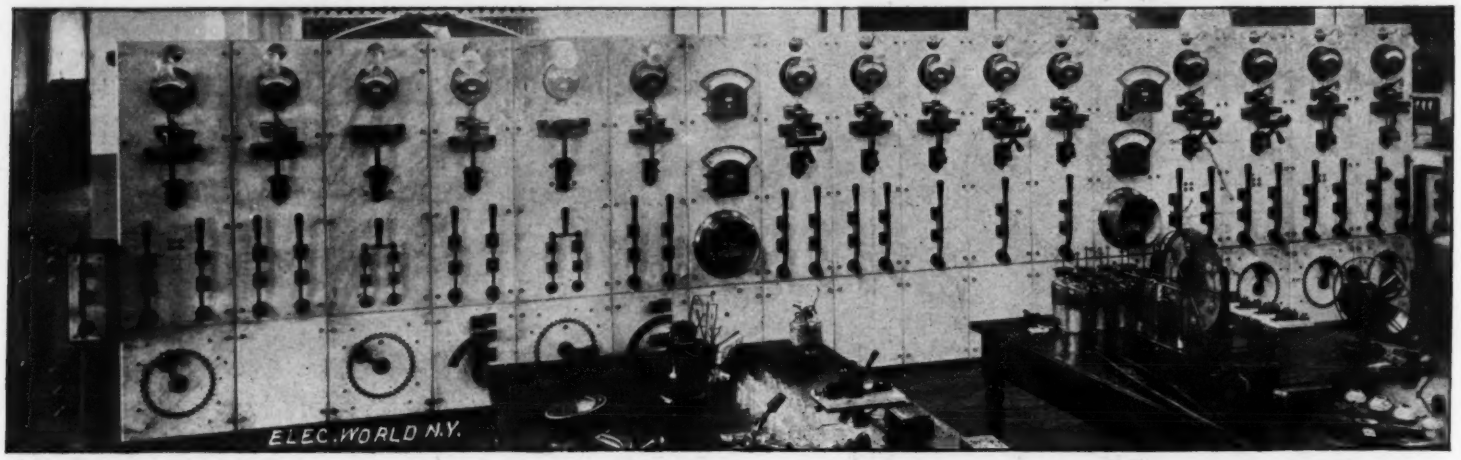


The Westinghouse 1000-hp Dynamo.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.

The Westinghouse Company gives in its extensive exhibit an idea of the tremendous range of apparatus which it manufactures. The largest dynamo of any kind in the exposition is shown here, consisting of a 750-kw engine type railway generator. Next in point of size to this is a 300-kw railway booster of a very compact design, there being but two bearings on the shaft, the two armatures therefore being allowed to come quite close togther. The motor end is compound wound, and the dynamo end, which has a capacity of 1000 amperes at 300 volts, is series wound. A 200-kw 500-volt generator is used as a motor, taking current from the power circuit of the exposition, and driving through a belt a 100-kw two-phase, 60-cycle compound wound alternator. This machine generates current which is stepped up in a 50-kw, 60,000-volt oil-insulated transformers of the type described in The Electrical World of March 5, 1898. The high potential current generated in this way is used to form a disrupted discharge on a large glass sign on which is printed the following slogan: "The name Westinghouse is a guarantee." Across one end of this exhibit is a seventeen-panel, 10,000 ampere, 500-volt switchboard, a large part of which is used in controlling the various machines in the exhibit.

In the railway motor line there are shown one 12A motor and two 38A motors, coupled together by a flexible coupling, by which one may be run as a motor and the other as a generator. A complete line of the type C induction motors is shown, ranging in size from a 100-kw down to a 2½-kw machine. In the line of stationary transformers are shown machines ranging from 50 kilowatts to five lights rated capacity. Complete equipments of Wurts' non-arcing lightning arresters with flat spiral choke coils mounted on marble panels for the protection of three-phase 30,000-volt lines are shown. In the line of historical instruments, the original experimental apparatus used by Tesla in his work on the rotary field is included in this exhibit. All sorts of auxiliary apparatus, long-burning arc lamps, washer type switches, plunger type switches, reinforced jaw type switches mounted on handsome pedestals for equalizer use, fan motors, Shallenberger meters, etc., are shown. The exhibit is in charge of Mr. C. W. Parkes.



The Westinghouse Switchboard.

The Exhibit of the Weston Electrical Instrument Company.

NEWS OF THE WEEK

Financial Intelligence.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK presents the following report for July, 1898: Gross earnings, $196,400, an increase over the same month for the year previous of $33,947; net earnings for the same interval, $66,552, an increase of $7,517; for the first seven months of 1898 the gross earnings were $1,738,123, an increase of $346,903; net earnings, $751,760, an increase of $121,011.

THE DIRECTORS OF THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY have authorized the issue of $3,500,000 fifteen-year 5 per cent, gold debenture certificates ,and sold $3,000,000 of such issue. Coupons mature January and July. The Mercantile Trust Company is trustee. The company has placed these certificates without creating any mortgage upon its assets, the company simply covenanting that it will not hereafter create any lien upon its property. The proceeds of the sale will retire outstanding floating and bonded indebtedness of the company, returning to its treasury as available assets stocks and bonds in various lighting and power companies yielding an annual income exceeding one-half of the interest charge of the debenture certificates. The saving in interest to the company will be important.

THE REDUCTION OF THE CAPITALIZATION of the General Electric Company was effected August 17 without any considerable opposition at the special stockholders' meeting in Schenectady, which had been adjourned from August 10. Mr. T. Jefferson Coolidge, seconded by M. Phelan, made the motion of the day in the form of a resolution, declaring that the capital stock of the General Electric Company be reduced from the present amount to $20,827,200, which shall consist of 182,760 shares of common stock, per value $100, and 25,512 shares of preferred stock, par value $100, the now existing common and preferred stock and the number of shares of each holder being respectively reduced to three-fifths of the present amounts. W. L. Putnam, representing the minority preferred stock, moved to adjourn and await the result of Mr. T. H. Livermore's litigation. The motion was put to a stock vote and lost, 243,141 to 9,800. Mr. Putnam also attempted to have a committee appointed to appraise the true valuation of the property, but Messrs. Coolidge and Ames affirmed their reliance on the board of directors, who had carefully considered the matter, and this amendment was also lost. Mr. Putnam protested that the vote was illegal, for four reasons: First, because the charter did not authorize the reduction; second, because such reduction would practically take 40 per cent. from the value of the preferred stock and give it to the common stock; third, because the common shares had been largely overissued and had remained unpaid; fourth, because there was no sufficient justification for reduction on any grounds whatever. Finding that the tide of the reduction movement was too strong to be resisted, Mr. Putnam finally succumbed with a last attempt to have the vote declared void. President Coffin overruled all these objections. The sworn tellers made their report through Mr. Darling, their chief. President Coffin declared that 243,141 votes were cast in favor of reduction and only 9,800 against it, and about $20,000,000 of excessive valuation was swept away in a moment.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, August 20, 1898.

THE UNITED STATES GENERAL APPRAISERS have given a decision on the question of the importation of long carbons and consequent avoidance of duty by virtue of the fixed tariff of 90 cents per thousand. The carbon importers have been bringing them in in extra lengths, even up to 36 inches, and cutting them up after paying the duty. The Treasury Department, however, counted every 12 inches as being one stick, and assessed the duty accordingly. The importers protested that this was illegal. The Board of Classification has settled the question by deciding that the goods come under another paragraph of the tariff bill, which provides for a duty of 35 per cent. ad valorem on goods made of carbon.

BIDS FOR PUBLIC LIGHTING IN BROOKLYN.—Bids for the lighting of Brooklyn streets for the coming year were submitted only by the Edison Electric Illuminating Company, of Brooklyn, now part of the Kings County Electric Light Company. The figures were as follows: For more than 3500 arc lights of 1200 candle power each, 34 cents each per night; for less than that number, 35 cents each per night. For current furnished for public buildings, 16½ cents per kilowatt hour. This rate for arc lights is 6 cents less than that charged by the New York Edison Company in Manhattan Borough, and the city officials are anxious to find out the reason why. Competition is practically ended in Brooklyn, the Citizens' Electric Illuminating Company and the Municipal Electric Light Company having been absorbed by the Edison Company, which in turn has combined with the Kings County Electric Light Company. The only competing company now in the field is the Amsterdam Electric Light, Heat & Power Company.

PHILADELPHIA NOTE.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., August 18, 1898.

THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS has established an American section, with the secretary's office in the testing laboratory at the City Hall in this city. The executive committee of the association at a recent meeting selected Saturday, August 27, and the Engineers' Club, 1122 Girard Street, as the date and place of the first annual meeting of the American branch of the association. The association, while new in this country, has a comparatively prominent standing in Europe, having about 1300 members. The transactions appear in its official organ, which is entitled "Baumatieralienkunde." Two conventions have been held, one in Zurich in 1895, and the other in Stockholm in 1897.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., August 19, 1898.

THE OPENING OF THE LOCKPORT TROLLEY LINE, which is about 25 miles long, was a complete success, everything working perfectly from the start. As with the Niagara Falls line, power is taken from the 11,000-volt mains of the Niagara Power Company. A transformer station has been established at Lockport for the supply of that end of the line.

COUNT A. VALENTINIS AND CHEVALIER A. LUZZATI, of Italy, who have been in this neighborhood some time examining the electrical development connected with the Niagara tunnel, are still at Niagara Falls. They speak of the success of the many undertakings as something wonderful. An examination of the new trolley line to Lockport was made on the turning on of the power.

ENGINEER STOTT, of the Buffalo General Electric Company, appears to have accomplished his purpose in going to Schenectady to get the new apparatus for use here in readiness for shipment. The list includes no less than seventeen transformers for stepping down the Niagara cable current. They will begin to arrive here next week, and will be set up at once in the new light station and other electrical centres of the local companies.

ELECTRIC SUBWAYS IN BUFFALO, under construction at the present time, make of it a most ragged city. Almost the whole of Niagara Street has been traversed, part of the work being still under way. The line through Genesee Street to the Urban flour mill has been tapped and extended through several east side streets in order to bring the current across Main Street under ground for street lighting purposes. None of the cable has been threaded into the new lines yet, except that the new lighting station has now been reached.

THE AMERICAN ELECTRO-THERAPEUTIC SOCIETY will hold its eighth annual meeting in Buffalo September 13-15. Besides the usual exhibitions of improved apparatus there will be present many notable electricians, who will take an active part. Papers will be read by Dr. Apostoli and Dr. Gautier, of Paris; Dr. Felice La Torre, of Rome; Dr. J. Inglis Parsons, of London, and Mr. Nikola Tesla, who is in especial repute here on account of his prediction of the success of the Niagara tunnel long before it was an accomplished fact.

THE GENERAL ELECTRIC COMPANY, of Schenectady, is reported as contemplating a removal of part at least of its works to some point on the Niagara tunnel line, between Buffalo and Niagara Falls, and may do so if a site is furnished. A local paper calls for a committee to take the matter up. It should not be forgotten that this company came near locating here at the time it collected its departments at Schenectady. If the present report is well founded it is certain that the company has increased its faith in the capacity of the Niagara tunnel to produce cheap power.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., August 19, 1898.

THE CHICAGO BELTING COMPANY'S WORKS at 67-69 Canal Street, Chicago, were destroyed by fire on August 15. The loss to the company is estimated by local papers at $30,000. All losses are said to be covered by insurance.

THE ELECTRICAL CLUB of the Chicago Central Young Men's Christian Association, which was formed for the purpose of giving instruction in practical electrical engineering and also for the promotion of a spirit of fraternity among the men interested in that particular line, is unusually active at the present time, preparing for its next season. The instructors for the following year are Mr. George A. Damon, who is associated with Mr. B. J. Arnold; Mr. Benjamin H. Glover, assistant electrician National Board of Fire Underwriters, and Mr. Truman P. Gaylord, electrical engineer of testing department, Chicago Edison Company. The club is equipping a laboratory, and invites the manufacturers of electrical supplies to help it in this work. To motor manufacturers the club wishes to state that the Cutler-Hammer Manufacturing Company has offered to make a starting box and rheostat to fit any motor. "Who will give us the motor?" A unique electrical entertainment will be given on Friday evening, September 16.

St. Louis Notes.

St. Louis, Mo., August 18, 1898.

NEW ELECTRIC LINE.—D. Houseman, Jr., is trying to interest capitalists in an electric railroad between Bobringville & Kemmswick. The line is expected to run over the telegraph county roads, and it is stated that the necessary franchises have been secured.

SUBURBAN LOOP.—The St. Louis & Suburban Railway Company's loop, for which it has had a franchise for over three months, has not been touched yet. The only action taken by the road was to appoint commissioners to assess what rental should be paid other roads that will be used.

NEW SUBURBAN BRANCH.—A special session of the County Court will be held Saturday to consider the petition of the St. Louis & Kirkwood Railway Company for a franchise to build a line from Brentwood through Clayton, the county seat, to Hodeamont, connecting with the main line of the Suburban.

THE EAST ST. LOUIS ELECTRIC STREET RAILWAY COMPANY and the Belleville & Suburban Railway Company are pushing things along the west ends of their lines. The East St. Louis Company promise a continuous connection between the bridge and the court house in Belleville by September 1.

THE COLLINSVILLE ROAD.—The capitalists interested in the proposed electric railway to Collinsville, Ill., have decided to push the line to completion. They say that a complete right of way has been secured, with the exception of a few feet, and the owners of those will consent to give these lands when the building of the road is an assured fact.

STRIKE ON NEW POWER HOUSE.—Work was closed down on the new power house of the Imperial Electric Light and Power Company this week on account of a strike ordered by the Building Trades Council. Non-union steamfitters employed by the McCloud Contracting Company, of Chicago, have caused the trouble. Between 80 and 100 men are affected by the strike.

KINLOCH EXCHANGE NEARLY READY FOR BUSINESS.—Manager Hauton, of the Kinloch Telephone Company, will begin testing his lines Monday. Within three weeks from date he expects to have the new system ready for business. At first seven girls will be put to work on a switchboard of 100 numbers, and when they become proficient they will in turn instruct other operators until the full quota is ready. No charge for the use of the system will be made until it is in complete working order. 'Phones in the residence districts will be the first put into commission.

Mississippi Notes.

Brookhaven, Miss , August 18, 1898]

THE LOCAL TELEPHONE EXCHANGE, of Brookhaven, Miss., is offered for sale by the owner.

THE COTTON SEED OIL MILLS now being built at Barlow, Miss., are in the market for a 50-light incandescent plant. Address H. H. Barlow.

AN ELECTRIC LIGHT PLANT in Hazelhurst, Miss., will be built by a stock company formed by G. N. Ellis and G. T. Ragsdale. The plant will consist of one 1000-light alternator and one 30-light arc machine. Twenty-five arc lights are to be used in lightning the streets of the city.

THE LOCAL TELEPHONE EXCHANGE in Hazelhurst, Miss., has been bought by Mr. T. Granberry, and the central office is now being removed to new quarters over the Merchants' & Planters' Bank. The exchange now has 125 subscribers, and Mr. Granberry expects to rebuild the entire system and equip it with latest improved telephones.

Mexican Notes.

Monterey, Mexico, August 17, 1898.

A METEOROLOGICAL DEPARTMENT in connection with the Federal telegraph service has just been established in this country.

A NUMBER OF PRIVATE ELECTRIC LIGHT PLANTS have recently been installed in this city. Nearly all of the large mines around Monterey are now equipped with their own electric light plants for illumination and power purposes.

AN ELECTRIC FIRE AND POLICE ALARM system has been placed in operation in the city of Mexico. It is an improvement that has been badly needed for a long time. The installation of the system was performed by an American firm of manufacturers.

AN ELECTRIC LIGHT AND POWER PLANT in the city of Oaxaca, State of Oaxaca, has been under consideration for several years, the promoter of the enterprise being Don Juan Prieto. It has recently been decided to utilize the falls of Vista Hermoso, San Juan and Molino Lazo as a motive power for the proposed light and power system. An aqueduct has been built from Cerezo to Etla, a distance of about 12 miles from Oaxaca, and it is expected that the installation of the new system will soon take place.

ELECTRIC RAILWAYS IN THE CITY OF MEXICO.—Advices have been received here from the city of Mexico that the Federal District Street Railway Company, of that city, has submitted the plans for building an electric street car line there to the national department of public works for approval. A decision as to the acceptability of the plans is expected in a short time, and the work of constructing the line will then immediately begin. It is the intention of this company to equip all of its lines in the city of Mexico with electricity, but the improvement is to first be applied to the Guadalupe and San Angel Mine, which traverses the most thickly populated part of the city and runs to the suburbs of Guadalupe, Chapultepec, Tacubaya, Mixcoac and San Angel. The principal power house will be located in the Indianilla district. The relaying of the tracks for electric traction and the installation of machinery and conduits will require about eighteen months.

Pacific Coast Notes.

San Francisco, Cal., August 14, 1898.

THE PACIFIC ELECTRIC MOTOR COMPANY has moved its factory and repair shop to 183 Jessie Street, San Francisco.

THE WYBRO-HENDY COMPANY is the name under which Mr. H. C. Wybro will superintend the sales of electric supplies at the uptown store of the Joshua Hendy Machine Works, of San Francisco. The new company carries the Pacific Coast agency of the Walker Company, Cleveland, Ohio.

THE SAN FRANCISCO "CHRONICLE" has installed an American-Ball direct-coupled engine and dynamo for lighting and power purposes. The new 125-volt machine has a capacity of 1000 lamps, and it will replace two Edison generators, driven by a rope transmission, that is out of date.

THE OREGON TELEPHONE & TELEGRAPH COMPANY has elected Mr. J. C. Ainsworth president, Mr. W. B. King having retired from that office. The switchboard capacity of the company's central office in Portland has been increased by fourteen stations, to accommodate a like number of operators.

THE SNOQUALMIE FALLS POWER COMPANY, which is to supply the cities of Seattle and Tacoma, Wash., with electric power generated in a station operated by water power, is reported as having closed a contract with the Westinghouse Electric & Manufacturing Company for four 1500-kw generators.

THE PORTLAND GENERAL ELECTRIC COMPANY'S "Station B" in Oregon City, Ore., is completed, and has all of its twelve sections in operation. It was constructed a few sections at a time. Ten of the sections contain one 6000-volt generator and two vertical turbines each; one section, turbines driving pumps, and one section, two exciters and two turbines. The total generator capacity is 12,800 horse-power. Each exciter has a capacity of 250 kilowatts at 125 r. p. m. The building is a solid block of concrete, and has a length, parallel with the Willamette River, of 364 feet. The voltage is 6000 on the transmission line to Portland, 14.3 miles in length. The station across the river has been sold to a paper mill company.

Canadian Notes.

Ottawa, Ont., August 20, 1898.

THE BELL TELEPHONE COMPANY'S directors have decided to increase the capital stock of the company from $3,168,000 to $3,900,000.

THE OTTAWA ELECTRIC COMPANY is about to increase its plant at No. 2 power house by the addition of a 60-inch waterw heel and a 125-light arc generator.

THE TORONTO ELECTRIC RAILWAY is reported as having entered a suit against the Siemens & Halske Electric Company, of Chicago, for $25,000 for breach of warranty of a generator.

THE MONTREAL ISLAND BELT LINE railway shareholders have authorized the directors of that company to issue new bonds to the extent of $380,000 and to cancel and redeem the old issue of $300,000.

TENDERS ARE INVITED up to August 30 for supplying an incandescent electric lighting plant for the city of Beeton, Ont. Mr. John Galt is the consulting engineer, and Mr. W. H. Mitchell is the chairman of the electric light committee.

THE RATEPAYERS OF THE CITY OF HAMILTON, Ont., have voted in favor of extending the franchise of the Hamilton Street Railway Company for a further period of fifteen years, or until the year 1928. The vote was strongly against the corporation in the proposition to assume control of the street railway.

PROFESSOR CALLENDAR, recently of the staff of McGill University, Montreal, has designed a platinum electrical resistance thermometer capable of measuring temperature to the ten-thousandth part of a degree. The extreme delicacy of the instrument makes it a valuable aid in securing accurate observations of the temperature of lakes' and rivers' water during the various seasons of the year, as no thermometer is available for such minute measurements.

THE CANADIAN MANUFACTURERS' ASSOCIATION, which has for its object the development of the manufacturing industries of Canada, has commenced the publication of a bulletin which will contain the information regarding the export trade of Canadian manufacturers. The association has appointed Tuesday, September 6, to be Manufacturers' Day at the coming Toronto fair, at which time it will hold a special meeting on the fair grounds.

THE TROUBLE BETWEEN THE OTTAWA ELECTRIC STREET RAILWAY COMPANY and its employees is reaching the acute stage. The company has already dismissed a number of its conductors for various reasons, but chiefly, it is said, because they belong to the union. The employees propose to appeal to the public of this city in order to enlist active popular sympathy on their behalf. The employees are asking for a ten hours' day the wage of $1.50, and are now offered $1.43.

General News.

New Incorporations.

THE INTERNATIONAL ELECTRICAL COMPANY, Cleveland, Ohio, has been formed by A. W. Mayers, E. H. Shaw and Charles Steaton, to manufacture electrical appliances. Capital stock, $10,000.

THE WORTHINGTON WATER & LIGHT COMPANY, Worthington, Ind., has been incorporated with a capital stock of $5000. The incorporators are John H. Brown, B. O. Mayer and F. McClellan.

THE MASON ELECTRIC LIGHT COMPANY, Mason, Tex., has been incorporated with a capital stock of $5500. The incorporators are L. Guggenheim, V. M. Loring, Otto Donoh and Richard Grosse.

THE HADAWAY ELECTRIC HEATING & ENGINEERING COMPANY, New York, N. Y., has been incorporated with the following named directors: Harold S. Mackaye and Nelson Heiss. Capital stock, $50,000.

THE TRANS-MISSISSIPPI TELEPHONE COMPANY, Omaha, Neb., has been incorporated, those interested being William B. Douglas, Warren P. Carlisle and W. P. Lathrop. The capital stock of the new company is $10,000.

THE QUAKER CITY TELEPHONE COMPANY, Quaker City, Ohio, has been incorporated with a capital stock of $500. Among those interested in the new enterprise are John R. Hall, J. W. Hill, H. S. Hartley and J. T. Douglas.

THE MORAL TELEPHONE COMPANY, Moral, Okla., has been chartered with a capital stock of $2000. It will run a line from Moral to Tecumseh, Lexington and Purcell. L. M. Lamm is president, and L. P. R. Miller treasurer.

THE GOSHEN TELEPHONE COMPANY, Goshen, Ind., has been formed with a capital stock of $30,000. The directors of the new company are James A. Arthur, George D. Lint and Wilson Roose, of Goshen; Edwin L. Barber, of Wauseon, and James S. Brailey, Jr., of Toledo, Ohio.

A COMPANY was organized August 18 in Philadelphia, Pa., for the construction and operation of telephone, electric light and electric railway plants in Southern and Middle States, the head offices to be at Atlanta, Ga. Mr. J. M. Wood, of Wilmington, N. C., was appointed general manager and purchasing agent. The company already has some franchises, and is in the market for electrical supplies.

THE ESMOND ELECTRIC TRACTION & SIGNAL COMPANY has been chartered in Charleston, W. Va., for the purpose of building, equipping and maintaining railways and signals and signal stations, and furnishing electric heat, light and power. The shareholders are D. N. Maxon, G. E. Cruse, C. S. Johns, D. A. Davies and R. H. E. Starr, all of New York. The capital stock subscribed is $500.

THE ONTARIO TELEPHONE & SWITCHBOARD CONSTRUCTION COMPANY, LIMITED, Toronto, Ont., has been incorporated with a capital stock of $75,000. The incorporators are Robert Fox, T. H. Smallman, F. B. Leys, T. H. Purdon, R. A. Bayly, John Labatt, Moses Masuret, John Milne, Dr. J. D. Wilson and J. R. Minhinnick, of London, and R. H. Evans and H. C. Walters, of Detroit.

THE DETROIT, UTICA & ROMEO RAILWAY COMPANY, Detroit, Mich., has been formed with a capital stock of $300,000, for the purpose of constructing and operating a suburban line that will connect Romeo and intervening points with Detroit. Among those interested are Alexander A. McVittie, Frank E. Kirby, Frank D. Andrus and Elliott G . Stevenson, of Detroit; George B. Davis, of Utica, and Marvil I. Brabb, of Romeo.

THE TELEGRAPH AND TELEPHONE.

KINGFISHER, OKLA.—Kingfisher is preparing to build a telephone system.

WORTHINGTON, MINN.—The Midland Telephone Company's line is now being constructed between Worthington, Rushmore, Adrian, St. Kilian and Ellsworth.

WICHITA, KAN.—Construction work has been begun on a second telephone line from here to Wellington. The line will run to Mayfield, Milan, Argonia, Conway Springs and Harper.

DESHLER, OHIO.—The Bell Telephone Company has purchased the lines of C. F. Heidley, of Leipsic, and will have in this city a general station for many of the adjoining towns.

MACKINAC ISLAND, MICH.—Mackinac Island is to have a telephone system. The Village Council has passed an ordinance granting a franchise to R. C. Stephenson, of Rochester, Ind.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association of this city has just completed a long-distance copper metallic circuit between this city and Hillsboro, via Williamsburg, Ohio, for through business.

MINONK, ILL.—The McLean Telephone Company was granted a franchise at a meeting of the City Council last week. This gives the company entrance into the city and the right to erect poles and lines along the streets.

LORAMIE, OHIO.—At a special meeting of the City Council the Union Central Long Distance Telephone Company was granted the privilege of building a line through this city. Right of way has also been secured from Minster via Houston to Sidney.

LA CROSSE, WIS.—The La Crosse & Southeastern Telephone Company has just completed a new metallic line to West Salem, Bangor and Sparta, connecting with the telephone line at La Crosse. This line connects also with Norwalk, Wilton, Ontario, Leon, Melvina and Tomah.

INDEPENDENCE, MO.—The American Telegraph & Telephone Company, which was recently granted a franchise over the streets of this place, will begin work on the line at once. The work will be pushed to compeltion, and the city will have the benefit of a long-distance telephone connection with Kansas City, St. Louis and Chicago.

POTTSVILLE, PA.—J. Jerome O'Neill, electrical contractor, of Lost Creek, has been awarded the contract by Superintendent Zehner, of the Lehigh Coal & Navigation Company, and the Tamaqua & Lansford Street Railway Company, to equip an exchange and twenty-three stations. The line will extend from Summit Hill to Nesquehoning, through Lansford and Tamaqua, connecting all the Lehigh Coal & Navigation mines, offices, shops and electric railway offices.

WASHINGTON, D. C.—General Greely has been informed by Colonel Allen at Ponce, Porto Rico, that the telegraph lines now extend from Ponce through Guayama and Arroyo to the headquarters of General Brooke, through Guayama to the headquarters of General Wilson, through Ajuntas and Utuado to the headquarters of General Stone and along the coast to Guanica. These lines all extend to the cable station, and they place this country in communication with more than half of the island of Porto Rico.

ST. PAUL, MINN.—The Mississippi Valley Telephone Company is making rapid progress in its exchanges at St. Paul and Minneapolis. The conduit work is all completed in both cities, and the outside work is well under way at the latter city. Mr. J. C. Hubinger, president, expects to make this exchange one of the strongest independent systems in the country, and when completed in the two cities it will have from 10,000 to 12,000 subscribers. The Stromberg-Carlson central energy telephones and switchboard will be used throughout.

ELECTRIC LIGHT AND POWER.

MATTOON, ILL.—The Mattoon Light, Heat & Power Company has been granted a twenty-year franchise by the City Council, and will at once begin the work of building a plant.

BORDENTOWN, PA.—The Monmouth Traction Company has absorbed a controlling interest in the Bordentown electric light plant. A large supply of material has arrived from Williamsport, Pa., for the purpose of increasing the size of the plant.

MOUNT PLEASANT, TEX.—Mount Pleasant is to have an electric light plant. It will be owned and operated by Davis Brothers, millers, who will utilize the engine and machinery of their mill. The plant will probably be in operation by September 15.

TRENTON, TENN.—A bill was filed in chancery here by Keenan & Wade, owners of the electric light plant, against the city, claiming a failure on the part of the Mayor and the Board of Aldermen to comply with a contract made with them to purchase the light plant for the sum of $8000.

QUINCY, ILL.—Mr. J. C. Hubinger, of Keokuk, Ia., has purchased the old ice-house property on Front Street, between Maine and Hampshire, for the sum of $4000. The lot is 101 by 100 feet, and on it will be built the power house for Mr. Hubinger's proposed electric light and steam heating plants.

CHICAGO, ILL.—Chicago Edison interests, acting presumably for the Commonwealth Electric Company, have arranged to purchase another electric lighting plant on the northwest side. The property is located at Milwaukee and Western Avenues, and is known in electrical circles as the "Miller" plant. It is said that the purchase price will be about $29,000.

BRISTOL, TENN.—The Bristol, Virginia Corporation has just completed the construction of an artesian well, and is about to purchase machinery for pumping from the same, and also in connection therewith for lighting the streets by means of some sixty or seventy-five arc lights. Mr. C. W. Hanna is the proper person to address with regard to estimates for this equipment.

REDLANDS, CAL.—A certificate of increase of the capital stock of the Redlands Electric Light & Power Company was filed in San Bernardino by W. J. Curtis, atttorney for the company. The increase is from $200,000 to $500,000, and is made in order to extend the scope of the company's operations, improve the plant, circuit lines, property, etc.

PASADENA, CAL.—The Edison Electric Company, of Los Angeles, has purchased the entire stock of the Pasadena Electric Light Company. About October 1 this company will begin furnishing power to the Edison Electric Company and the Los Angeles Railway Company in Los Angeles, and the Pasadena Electric Light Company and the Pasadena & Los Angeles Electric Railway Company. The officers of the company are George H. Barker, president; William R. Staats, secretary; John B. Miller, treasurer; W. S. Wright, attorney. The new company proposes to make many improvements, introduce water power and reduce rates.

THE ELECTRIC RAILWAY.

MARION, IND.—Electric street cars are now running from Marion to Summitville.

SOLVAY, N. Y.—The Board of Trustees of this village has granted a franchise to the Syracuse, Skaneateles & Moravia Railroad Company to build its road through the village.

PHILADELPHIA, PA.—The Southwestern Street Railway Company has begun the work of laying track for its line through the hitherto undeveloped country in the southwestern section of the city, from Mayomensing Avenue to the county line.

PLAINFIELD, N. J.—At a recent meeting of the Common Council the Plainfield Street Railway Company was granted a franchise for an electric railway through the streets of Plainfield to connect with the Elizabeth & Westfield Street Railway Company.

MILWAUKEE, WIS.—A building permit has been issued to the Milwaukee Electric Railway & Light Company to erect its new power station at the corner of River and Oneida Streets. The building is to be of brick and stone, 100 by 130 feet. The cost is given as $98,000.

BUFFALO, N. Y.—Mayor Diehl has signed the resolution of the Common Council so amending the grant of the Buffalo Traction Company as to revoke the rebate check and 4-cent fare provision, and to permit a 5-cent fare and a system of transfers between all lines in the city.

JACKSON, MICH.—A decree has been entered in the Circuit Court, ordering the sale of the street railway by the Circuit Court commissioner, naming the time after August 31, to satisfy the mortgage held by the Fidelity Loan & Trust Company. The amount claimed is $171,829.50. The property has been in the hands of a receiver for the past year.

BROOKLYN, N. Y.—The plans and specifications for the construction of the incline at Flatbush and Atlantic Avenues, which will connect the Brooklyn Elevated Railroad system and the surface line of the Long Island Railroad on Atlantic Avenue, have been completed, and bids for the immediate construction of the work are now being received.

CHESTER, PA.—The Wilmington extension of the Union Traction Company's line, which is to connect the city of Philadelphia with Wilmington, is well under way. The tracks have been laid through this city and the men are now working on the section that leads to Clarmont, Del. It is thought that the through line will be completed within two weeks.

WEEHAWKEN, N. J.—The New Jersey Elevating & Transfer Company has begun the construction of an inclined railroad which will hoist two score of passengers at one time nearly 200 feet within a short horizontal distance. The

new railroad will be of steel, and either steam or electricity will be used as a motive power. The grade is said to be the steepest traversed by any railroad in the country—72 in 100 feet—and will constitute the road practically an elevator.

DEFIANCE, OHIO.—Some months ago Mr. W. R. Faben, receiver of the Defiance Light & Railway Company, made application to Judge Hubbard for authority to sell the electric railway property in this city. At that time the creditors of the company objected, but now Judge Hubbard has given permission to sell the electric road. It is stated that the road will be sold in a few days to parties who will put it in operation. The road has not been running for more than a year.

ST. LOUIS, MO.—The stockholders of the electric railway company which contemplated the construction of an electric railroad from East St. Louis to Edwardsville and Alton have sold the franchise to the Mississippi Valley Electric Railway Company, of which J. H. Mehling, of St. Louis, is president. The Mississippi Valley Company proposes to construct two car lines, one from East St. Louis to Alton, via Brooklyn, Madison and Granite City. The other road will be from East St. Louis to Edwardsville, via Collinsville and Glen Carbon.

Personal Note.

MR. MARTIN J. INSULL, of Chicago, formerly of the engineering firm of Sargent & Lundy, has been a visitor in New York during the last week. While there, Mr. Insull arranged with the C & C Electric Company to represent it in the Chicago territory, with headquarters in rooms 1012 to 1013 Monadnock Block. Messrs. Sargent & Lundy have during the past year represented the C & C Electric Company in Chicago, with Mr. Insull in charge of the electrical department, but with Mr. Insull's recent withdrawal from the firm the C & C agency was relinquished. Mr. Insull's long experience in the electrical field, his extensive acquaintance, his thorough familiarity with C & C apparatus and the excellence of the product of the C & C Electric Company should assure the success of his efforts.

Trade and Industrial Notes.

THE WASHINGTON ELECTRIC LIGHT COMPANY, Washington, Pa., is increasing its plant by the addition of a 200-hp engine, built by the Ball Engine Company, Erie, Pa.

THE WESTERN BELL WORKS, 69-71 West Jackson Boulevard, Chicago, are now owned solely by Mr. W. S. Hodgman. The business will be actively pushed under his personal supervision.

A NEW FACTORY for the Western Electric Company is to be built on South Clinton Street, Chicago, Ill. The building will be of brick ten stories high, 180x100 feet, and will cost about $150,000.

THE ST. AGNES HOSPITAL, Philadelphia, is to have an isolated electric plant. The engines, which are to be built by the Ball Engine Company, Erie, Pa., will be direct connected to Eddy dynamos.

THE DEARBORN DRUG & CHEMICAL WORKS, of Chicago, have recently analyzed fourteen boiler-feed waters and shipped two carloads of suitable scale solvents to large sugar concerns in the Hawaiian Islands.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., reports a large demand for its dividend circuit toll line telephones, which the company guarantees to be free from the claims of the Carty patent and to be superior to the bridging system.

THE SCHEEFER METERS AND TRANSFORMERS will be handled in the States of Michigan and Indiana by the Illinois Electric Company, 239 Madison Street, Chicago, which has just secured the exclusive agency for these States. The company states that it is in a position to make prompt shipments and low prices.

H. M. SHAW & CO., 40 Broad Street, New York City, report increased business on Partridge carbons, Quaker City dynamos and motors and Nowotny inclosed arc lamps. The Universal Electric Company, manufacturer of the Universal non-arcing lightning arresters, for which H. M. Shaw & Co. are general agents, reports the largest trade this season of any since its incorporation six years ago.

SELF-LUBRICATING CARBON BRUSHES will have their merits explained to the delegates to the American Street Railway Association convention by Mr. J. S. Speer, secretary of the Partridge Carbon Company, of Sandusky, Ohio, who will attend the convention for this purpose. These brushes are valuable both for generator and railway motor work, and are coming into wide use in the railway field.

DEVELOPING LARGE GAS ENGINES.—The Westinghouse Machine Company surprised the visitors to the recent soiree at East Pittsburg by its 650-hp gas engine, but it now proposes to exceed this greatly by the construction of engines of 1000 or more horse-power. The advantages of gas engines over steam boilers and engines are so great that they are practically certain to displace the latter in large as well as small work, and the Westinghouse Machine Company intends to be prepared for the demand that will be caused thereby.

THE JULIUS ANDRAE & SONS COMPANY, of Milwaukee, has secured the agency for the famous Ericsson telephones in the Badger State. Mr. James Healey, who recently returned to Milwaukee from a trip through Northern Illinois in the interest of this company, states that the business conditions in the rural districts are very favorable. The splendid crops of the season have made it possible for the farmers to put in telephones and necessities in the electrical line. The company also report that it is experiencing a healthy run on "O. K." batteries.

THE THREE MAIN GENERATORS mentioned and illustrated in the article describing the isolated plant of the R. G. Dun Building, published in The Electrical World of August 13, 1898, were constructed by the Walker Company, of Cleveland, Ohio. The use of any apparatus in this building is a compliment to the builder, as the whole structure was built on the principle that no expense should be spared to get the best and most reliable. The adoption of Walker machinery for the main generators is, hence, appreciated by the Walker Company.

THE NEW YORK & OHIO COMPANY, manufacturer of the celebrated Packard transformer, has recently brought out its latest model, which is to be known as "Model 98." The results secured on this new model are considerably ahead of anything that has been obtained heretofore in the way of regulation and efficiency. The Electric Appliance Company, general Western agents for the Packard transformer, is ditributing special circulars of the same, giving tabulated results of a number of tests. The manufacturers of this transformer are prepared to guarantee these results on each and every transformer sold, and a large fall trade is looked for on the "Model 98."

THE MASON & RICHARDS COMPANY, Security Building, St. Louis, Mo., states that in addition to the agencies of the Walker Company and the Keystone Electric Company it has selling agencies for the following desirable companies: Cutter Company, "I-T-E" circuit breakers; Keystone Electrical Instrument Company, instruments; Raster Carbon Rheostat Company, rheostats, dimmers, etc.; Electric Railway Equipment Company, railway supplies; Simonds Manufacturing Company, gears and pinions; Partridge Carbon Company, carbon brushes; K. & W. Company, incandescent lamps; Ham Sand Box Company, sand boxes; Diamond State Fibre Company, fibre; Monarch Stove Company, track cleaners, and other companies, enabling it to quote attractive prices on all sorts of electric railway material and supplies.

THE "JAGABI" PORTABLE TESTING SET.—Mr. J. G. Biddle, 910 Drexel Building, Philadelphia, reports a very good demand for the new "Jagabi" portable testing set, which he is selling for Willyoung & Co. The Philadelphia & Reading Railway Company has ordered several sets for testing the signal systems on its various divisions, and among other recent customers may be mentioned the United States Naval Academy, Central Union Telephone Company, Jenney Electric Motor Company, Ahearn & Soper, J. H. Bunnell & Co., Western Electric Company, engineer's office District of Columbia, etc. The "Jagabi" portable testing set is probably the most compact instrument of its class on the market. It comprises a Wheatstone bridge, rheostat, D'Arsonval galvanometer, silver chloride battery and keys for galvanometer and battery, all mounted in a handsomely finished mahogany case. The theoretical range of measurement is from one one-thousandth ohm to over eleven megohms. Mr. Biddle will be glad to mail descriptive pamphlet No. 295 to anyone interested in the subject.

RHEOSTATIC DEVICES OF ALL STANDARD TYPES, including automatic motor starters, field rheostats, theatre dimmers, constant potential arc light resistances, etc., are now on the market, with carbon as the resisting material, as made up by the Raster Carbon Rheostat Company, Ashland Block, Chicago, Ill. The advantages of this material are obvious on a little thought. It will stand a temperature far greater than that of any metallic resistance without breakdown. Its resistance is practically unaffected by the temperature, so that like results are always obtained on the same adjustment of the rheostat handle. There are no coils to sag or cross or break when rendered brittle by heating. These advantages have always been recognized, but difficulties have been found in the construction of carbon rheostats, particularly in the contacts with the carbon. This difficulty has been overcome by the Raster Carbon Rheostat Company by the use of a special composition. The external appearance of these rheostats is very similar to that of open-coil instruments, the same provision being made for ventilation and a thorough circulation of air over the surfaces of the resisting parts.

THE LARGEST ARC DYNAMO.—There is now nearing completion at the Rushmore Dynamo Works, Jersey City, what will be the largest arc machine ever constructed. It will operate on the new multi-circuit system lately perfected by Mr. Rushmore, and at 500 r. p. m. will supply two independent circuits of 150 ten-ampere arc lamps each, or a total of 300 arcs. This is said to be double the capacity of the largest machines now in service. The machine has four poles, and resembles an ordinary constant potential generator. Unlike other so-called multi-circuit machines, the circuits are in parallel and cannot be connected in series. Each circuit has a separate pair of brushes and brush rocker, and the regulation is effected by a slight automatic shifting of the rockers. There is no sparking, and either circuit may be opened or short circuited under any load without the least effect on the other circuit. Mr. Rushmore is now designing a much larger machine to supply four circuits and be coupled direct to a Willans engine. The machines will be put in under the fullest guarantees, and it is expected that the efficiency will be nearly as high as in the latest constant potential generators of the same kilowatt capacity.

Trade and Miscellaneous Publications.

ALL STYLES OF CONVEYING MACHINERY from chain links to electric motors are described in a special price list of the Jeffrey Manufacturing Company, Columbus, Ohio. Of particular interest to electrical readers are the coal and ash handling equipments for power plants, Jeffrey mine equipments, including electric locomotives, coal cutters, drills and other parts of complete outfits and motor driven spiral chain and belt conveyors for all sorts of automatic handling operations.

"SNOW SWEEPERS, SNOW PLOWS AND TRACK SCRAPERS" is the title of a special catalogue dated August, 1898, published by the J. G. Brill Company, of Philadelphia. Electric railway managers may not think this a very appropriate subject in the present hot weather, but they are admonished in this catalogue of the old adage, "In time of peace prepare for war." Besides the standard sweepers, nose and shear plows, the catalogue describes an ingenious combination of snow plow and construction car, and illustrates one such double-truck car as used upon the Lorain & Cleveland Railway. It is fitted with four G. E. 57 motors, interchangeable nose and shear plows and wings. If the plows and wings are removed it can be used in summer as a construction car or as a locomotive for hauling cars or trains, its weight and powerful motors making it of value for the latter service.

"COSTLY ERRORS" is the title of an elegantly printed pamphlet published by the Calculagraph Company, of New York City, the contents being written by Mr. Henry Abbott. The work describes the various methods of timing toll

messages in telephone service, showing the errors likely to occur with clocks and personal estimation, and the advantages of the calculagraph over clocks, ordinary time stamps or stop watches. The calculagraph combines the good points of the time stamp and stop watch, or, in fact, a battery of stop watches, in that there is no necessity for any mental subtraction of the time of conection from the time of disconnection, the calculagraph doing this work automatically and stamping the slip or ticket with the time interval, and if desirable with the time of day also. One calculagraph will handle also as many toll line trunks as one or even several operators can manipulate, since the instrument does not need to be devoted exclusively to one line as does the stop watch while that line is in service, but may print tickets as fast as they can be slipped in.

"MICA AND MICANITE" is the name of a new catalogue recently issued by the Mica Insulator Company, of New York, and full of information for the electrical engineer, manufacturer and street railway man. An illustrated account of mica mining in India makes a capital introduction to the catalogue. Micanite is shown to be truly American, but although only five years old it is known in every country that can boast of an electric dynamo or motor. The work includes tables giving data of all kinds of some twenty-five different insulating materials. There is an article upon the construction of commutators which includes tables of various data and sketches of the latest designs. Micanite plate, flexible micanite plate, micanite cloth and paper, red paper and mica insulations, micanite rings, troughs, washers, tubes, spools, cylinders, etc., have each their descriptive page. Complete insulations for fifty-one different types of street railway motor commutators are kept in stock. The number of types will give an idea of the extent of the electric railway business. The other materials manufactured by the company include "Empire" oiled cloths, oiled papers, oiled linen, oiled asbestos, etc., and similar materials treated with "M I C Compound."

"PARTY LINE SERVICE" is the title of a wall poster lately issued by the Western Telephone Construction Company, of Chicago. The poster goes most elaborately into the details concerning the general construction of series and bridging party line systems, and describes the Western "Express" long-distance telephone, which is made for both series and bridging work. The means adopted for avoiding the Carty patent on bridging bells are explained, consisting of a novel arrangement of the generator and bell circuits by which the generator, instead of being normally on open circuit and bridged onto the line when in use, is normally on short circuit in series with the local ringing bells. When its crank is turned, however, the short circuit is opened as in ordinary exchange and series work, and a low resistance coil is shunted around the ringing coils so that the high resistance of the latter does not impede the generator current to line. One advantage of this arrangement is that the ringing coils at the transmitting station do not shunt off any of the current. The poster also gives detailed directions for the running of party lines, and describes the special apparatus manufactured by the company for the equipment of junction or switching stations for use on bridged toll lines. The methods of transposing metallic circuits and of protecting the instruments from lighting are explained, and the various parts of the Western Telephone Construction Company's equipments are described in full. A novelty brought out by this company and described in this poster is the H. C. D. combined carbon and fuse lightning arrester, consisting of the usual carbon blocks, with mica separating strips, to give the lightning a discharge path to ground, and fuse strips between these blocks and the instruments to cut off any excess currents from the latter.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, third Friday of each month; J. R. Cravath, secretary.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, New York.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA., Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl.

MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—F. W. Putnam, secretary, Salem, Mass.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope. Meeting, third Wednesday of each month.

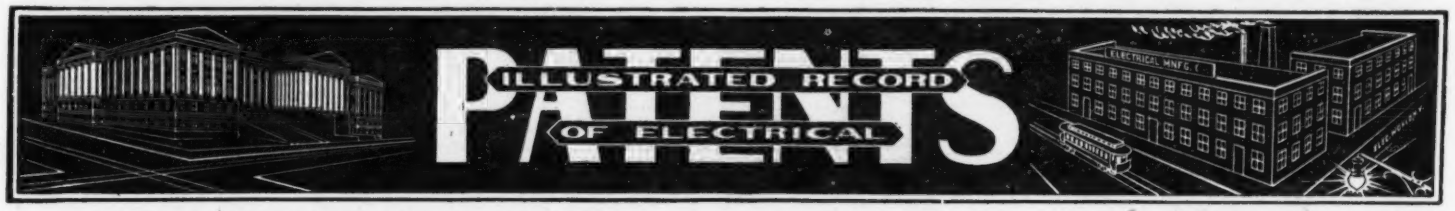
NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn; secretary, George F. Porter, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, A. E. Lang, Toledo, Ohio; secretary, T. C. Penington, Chicago, Ill. Next meeting, Boston, Mass., September 6, 7, 8 and 9, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED AUGUST 16, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

609,015. ELECTRIC ELEVATOR; R. Eickemeyer, of Yonkers, N. Y. App. filed Jan. 5, 1891. The combination of an elevator, and its hoisting mechanism; an electric motor coupled thereto, and a dynamo-electric governor mechanically driven by said motor for generating electricity, and distributing it in the magnetic field of the motor, and weakening said field, in proportion to any increase of speed in the elevator, beyond its desired or predetermined rate.

609,016. ELECTRIC ELEVATOR; R. Eickemeyer, of Yonkers, N. Y. App. filed May 3, 1892. In elevator machinery, the combination with the traveling car body or platform, of a compound motor, a resistance in shunt relation to the series coil of said motor, and a solenoid automatically controlling the magnetizing power of said series field coil by gradually short circuiting said resistance.

609,043. MOTOR CAR; C. O. Palmer, of Cleveland, Ohio. App. filed April 18, 1894. The combination of a car, a motor, a driving wheel driven by said motor, a friction controlled driving connection from said motor to the car axle, a reel and a flexible conductor wound on said reel and connected with both the motor and a dynamo, engine or other source of energy, together with a mining machine, a horizontal pulley on said mining machine, and a flexible band connection between the mining machine pulley and the motor pulley.

609,092. ELECTRIC CONTROLLER; J. D. Forrer, of Johnstown, Pa. App. filed July 11, 1898. A pair of concentric shafts, operating levers for the same, mechanism permitting independent rotation of said levers, but preventing independent vertical movement of the same and a lock for preventing simultaneous vertical movement except at a predetermined position.

609,124. ELECTRIC BRAKE; Ernest B. Skinner, of Ogden, Utah. App. filed Oct. 30, 1897. In an electric brake, a solenoid and plunger therefor for operating the brake mechanism, a second solenoid disposed at right angles to the first mentioned solenoid, a lever connected at one end to the plunger of the smaller solenoid and at the other end to links, which are connected to a plate carrying a shoe, a plate having a projecting portion for engagement with the end of the lever beyond the links, a shoe carried by said plate and a spring positioned between the plunger of the smaller solenoid and the links to operate upon the lever, adjacent to the plunger of the smaller solenoid.

609,142. COMBINED BATTERY AND ELECTRIC CELL; J. C. Dagoneau, of Beaufort, France. App. filed Jan. 15, 1895. In a combined battery and electrolytic cell, the combination of a cell or container containing sulphate of copper, an interior cell or container contained therein and comprising a rectangular framework of slats and membranes secured upon this framework, and constituting the walls of the interior cell, a zinc element and dilute sulphuric acid contained in the said interior cell, suspension bars adapted to suspend the articles to be plated, circuit connection between the zinc plate and the bars and one or more perforated lead plates in the interior cell upon which a copper deposit will be made.

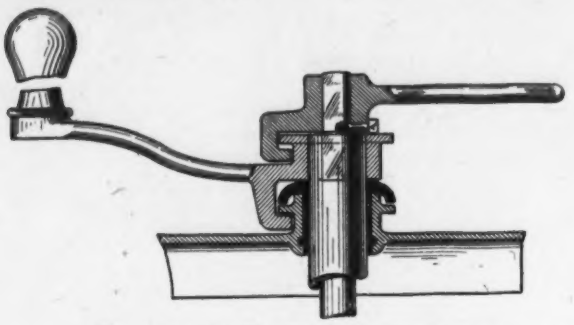
609,154. ELECTRIC TELEGRAPHY; O. J. Lodge, of Liverpool, England. App. filed Feb. 1, 1898. In a system of Hertzian wave telegraphy, the combination, with a pair of capacity areas, of electrical means having a spark gap inserted between them and serving to syntonize them, and means for bridging or shunting the spark gap whereby the apparatus is adaptable for use at will, either as a radiator or resonator.

609,173. TELEPHONE SYSTEM; A. F. Swan, of Bayonne, N. J. App. filed Sept. 29, 1897. The combination with the telephone apparatus, the line and the switch barrel moved by makes and breaks in the line, of the movable switch arms directly controlling the circuit through the apparatus, and means for operatively actuating the arms by the movement of the switch barrel.

609,188. ELECTRICAL TRACTION; W. Kingsland, of Llandudno, Eng. App. filed Dec. 23, 1897. In electrical traction, the combination with a continuous main electrical conductor, sectional working conductors from which the motor car directly collects the current, a number of sectional auxiliary conductors, one such for every sectional working conductor, and through which auxiliary sectional conductors the current is passed from the main conductor to the sectional working conductors, commutator switches situated at each end of the sectional auxiliary conductors, and electromagnets having soft-iron armatures fixed on rocking shafts whereby the commutator switches are operated; of auxiliary commutator switches, one such for each electromagnet, also operated by the rocking shaft to control the action of the electromagnet by connecting it with one or other of two adjacent sectional working conductors whereby the electromagnets may be

energized by a current coming from one or other of two adjacent sectional working conductors.

609,229. TELEPHONE SYSTEM; C. E. Egan, B. L. Lawton and E. C. Wilcox, of Meriden, Conn. App. filed April 9, 1897. In telephone systems, spring jacks, each provided with a central telephone connecting spring, a generator connecting spring, and a subscribers' communicating spring; a plunger fitted to reciprocate in each spring jack to engage either of the first two named springs; and a pair of connected plugs, each fitted to operate a plunger and provided with a metallic nib fitted to engage a subscribers' communicating spring.



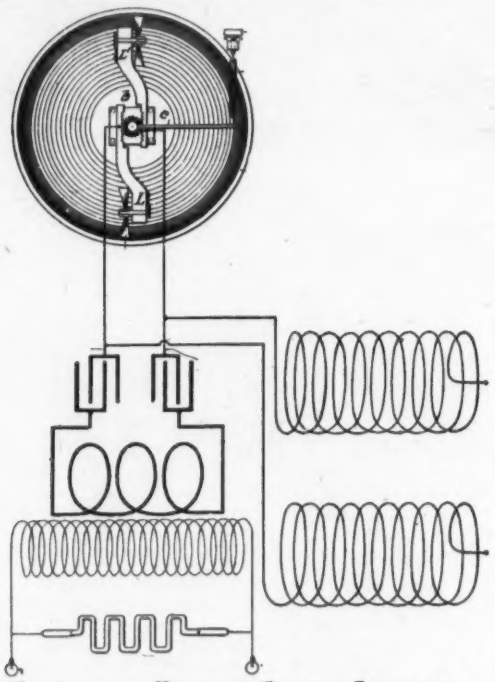
No. 609,092.—Electric Controller.

609,231. MEANS FOR INDICATING A SHIP'S ROLL; J. J. Hicks and G. H. Zeal, of London, Eng. App. filed Nov. 18, 1897. The combination of an annular tubular glass chamber half filled with mercury, a vertical board or plate carrying such chamber and adapted to oscillate it, and an annular scale surrounding the same.

609,245. ELECTRICAL CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed Dec. 2, 1897. The combination with a receptacle for containing a conducting fluid and a series of spaced conductors thereon, of a duct having an orifice directed toward said conductors and forming a conduit through which the fluid, when the receptacle is rotated, is forced and thrown upon the conductors.

609,246. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed Dec. 28, 1897. A circuit controller, comprising in combination means for producing streams or jets of conducting liquid forming the terminals, and means for bringing the jets or streams of the respective terminals into intermittent contact with each other.

609,247. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed March 12, 1898. The combination with a receptacle mounted to revolve upon an axis inclined to the vertical, of a spindle within the receptacle and eccentric with its axis, a weight eccentric to the spindle, and a terminal carried by the spindle and adapted to be rotated



No. 609,251.—Electric Circuit Controller.

by a body of conducting fluid contained in the receptacle when the latter is rotated.

609,248. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed March 12, 1898. In an electrical circuit controller, the combination with a rigid terminal, of means for directing against such terminal a jet or stream of conducting fluid in electrical connection with the other terminal, and a body adapted to be intermittently moved through and to intercept the stream or jet.

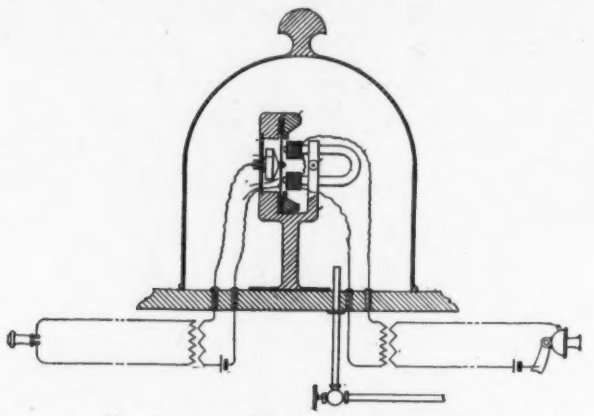
609,249. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed March 12, 1898. In a circuit controller, the combination with a rotary receptacle, of a support for a conductor mounted thereon concentrically with the receptacle, and a gyrostatic disc carried by the support and adapted, when rotating, to oppose its movement in the direction of rotating of the receptacle.

609,250. ELECTRICAL IGNITER FOR GAS ENGINES; Nikola Tesla, of New York, N. Y. App. filed Feb. 17, 1897. In an apparatus which depends for its operation or effect upon the production of a sudden electric discharge at a given instant, or at predetermined intervals of time, the combination with a moving part of said apparatus of a switch of commutator, a condenser, a charging circuit for the same, a primary circuit through which the condenser discharges, and a secondary circuit in inductive relation to the said primary circuit, and connected with the terminals at the point in the apparatus where the discharge is required, the switch or commutator being operated by the said moving part to effect the discharge of the condenser at the proper intervals.

609,251. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed June 3, 1897. A circuit controller, comprising, in combination, a receptacle containing a fluid, means for rotating the receptacle and a terminal supported independently of the receptacle and adapted to make and break electric connection with the receptacle through the fluid.

609,252. ELECTRIC RAIL BOND; J. S. Tucker, of Chicago, Ill. App. filed Jan. 20, 1897. A rail bond, comprising a conductor having its end portions provided with inwardly tapering enlarged heads, said heads being provided at their inner or smaller ends with flanges.

609,274. SYSTEM OF CONTROL OF ELECTRIC MOTORS; E. R. Gill, of Englewood, N. J. App. filed April 4, 1898. In a circuit governing switch, two sets of stationary contacts, a pivoted lever moving over the same and carrying one end of the circuit to be governed; in combination with a



No. 609,374.—Telephone Repeater.

brush selector whereby the circuit end on said lever may be brought into electrical relation with one or the other set of stationary contacts.

609,288. MEANS FOR FASTENING INSULATOR PINS TO CROSS ARMS; L. Mitchell, of Augusta, Ga. App. filed May 10, 1898. An insulator pin provided with an annular groove in its shank triangular in cross section, and an open ring of a spring material adapted to be contained within the said groove.

609,298. PRIMARY BATTERY; W. Rowbotham, of London, Eng. App. filed Feb. 24, 1898. A primary battery, comprising a plurality of cells having each an open and a closed compartment, porous tubes extending through the open compartment and opening into the closed compartment, the negative electrode rods located in said tubes, a closed tank for the exciting and depolarizing fluid, having flow and return pipe connections to the closed compartments, and means for supplying water to the open compartments.

609,300. WINDING MACHINE; E. J. Satterwhite, of Falls City, Neb. App. filed Sept. 10, 1897. A winding machine, comprising a reciprocating carrier, a shifting mechanism located upon the carrier to change the direction of its travel, and rotary stops, each located at one end of the path of the carriage and adapted to engage and operate said shifting mechanism.

609,309. FIRE ALARM; H. Tersling, of Copenhagen, Denmark. App. filed March 15, 1897. The combination of a three-armed pawl, means for tripping one arm of said pawl, a member restrained by a second arm of the pawl and a supporting arm having a shoulder capable of holding the third arm of the pawl.

609,331. TELEPHONIC MEASURED SERVICE SYSTEM; W. W. Dean, of Boston, Mass. App. filed Nov. 16, 1897. The combination in a telephone exchange system of a subscriber's circuit connecting two sub-stations with a central station, call-sending devices at the sub-stations, call-answering devices at the central station, and two call-registering mechanisms associated with said circuit at the central station, actuated by the normal operation, successively, of the call-sending devices of either sub-station and the central call-answering devices, for discriminatively counting and registering the calls of the said stations.

609,356. ELECTRICAL CONDUIT BOX; H. Krantz, of New York, N. Y. App. filed May 6, 1898. A split conduit box provided with corresponding semi-circular rims on the two parts of the box to form the outlet openings for the conduits, in combination with closing discs held in place by the two parts of the box when fitted together.

609,374. TELEPHONE REPEATER OR RELAY; J. S. Stone, of Boston, Mass. App. filed Dec. 29, 1897. A telephone relay, comprising an electromagnet in one circuit, transmitting electrodes in a second circuit, a diaphragm common to both said electromagnet and said transmitting electrodes, and a vacuum chamber inclosing said magnet, electrodes and diaphragm.